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AN INTERESTING USE OF A PORTABLE MOTOR.

An interesting use of a portable electric motor has been made at the new power-house of the London County Council. This recent addition to the British metropolis's power plants is undoubtedly one of the finest and best equipped in that city. It is located at Greenwich, where ample water was available for condensing purposes. The condenser pumps are driven by three-phase motors, which, of course, run at a constant speed, and the control of the water delivered by them is by means of valves operated by a worm and wheel. The power to drive the worms is obtained from a small portable motor fitted with back gears and a flexible shaft. The motor can be wheeled to the point desired, the flexible shaft connected to the worm, and the valve is thus put under electrical control.

The ease with which the electric motor is controlled is largely responsible for the increasing use being made of it for driving the power-house auxiliaries. The instance referred to above is another of this kind which is of particular interest, as but one motor is required to control the entire set of valves, and because it makes possible the controlling of the valve from a distance, which is of particular interest in this case since the method of driving the pumps makes frequent movement of the valves necessary.

A FEATURE OF MUNICIPAL OWNERSHIP.

At the time when advocates of municipal ownership in this country are making the most noise, in England, to which country they are accustomed to point for shining examples of the benefits of this system, the opponents of what they call municipal trading are making a strong fight. At a recent meeting of the Industrial Freedom League, Lord Avebury made an address in seconding the movement to adopt a report to the league on this subject. Many of the points made by the speaker against this practice have been stated again and again. One of them, however, does not seem to have received the attention it deserves. This is the danger that the question of municipal operation may become political, for in that case both the good of the public and the success of the undertaking become secondary matters to party success. At the present time in this country it is being urged as an economic question, the object being to reduce the cost of the service, first to the city itself for public uses, and then to the citizens. Such arguments are, of course, entirely proper and should be viewed upon their merits, but if any party gets into power mainly because it advocated such policy, it is pretty sure to make it a party policy, in which case the economic side is lost sight of and men vote for or against it because of their belief on other questions.

Another point made by the same speaker is frequently overlooked. Those who attack the public utility companies are fond of pointing out the large profits made, but they lose sight of the fact that during the early years in which the industry was established the profits were very small, or in some cases undiscoverable. It is not unusual, when introducing a new business, to expect a loss for the first few years, which will be made up by the profits that follow. Where such conditions have prevailed, it is unjust to expect the company to be satisfied with the small profit which would have sufficed had the business been a paying one from the start.

NITRATES FROM POWER GAS.

Evidences of the interest in the problem of fixing atmospheric nitrogen, so as to make it available for plant food, have been numerous of late. Only a short time ago we commented upon the group of excellent papers on the subject read before the Bunsen Society at its Dresden meeting, and now another process is put forward which is entirely new and possesses some features of peculiar interest. This problem was first of all chemical, then became electrical, and in this stage progress was made to such an extent that it becomes merely a question of the cost of power. Now another step has been taken, whether backward or forward remains to be seen; but it carries the problem over into the field of gas engineering.

The new process is due to a German engineer named Häusser, and is described in a paper presented by him at a recent meeting of the Society of German Engineers. An interesting discussion of this paper is contributed by F. E. Junge to *Cassier's Magazine* for August. It has been noticed frequently that the exhaust gases from gas engines, if running hot, seems, from the odor, to contain nitric oxide, and this has suggested that it might be commercially feasible to bring about the combination of nitrogen and oxygen in such a device. The process, as described, contemplates the use of so-called producer gas. To bring about the reaction it is necessary to raise the gas to a comparatively high temperature, which temperature must be under control; and the gases must be cooled down immediately after the reaction has taken place. The heating may be brought about by compressing and igniting a mixture of gas and air as is done in gas engines. Häusser's plan is to compress the mixture of producer gas and air in a gas engine. At a certain point during compression ignition is brought about, and the combustion raises the pressure and the temperature to a point high enough to bring about the reaction. To prevent the decomposition which would follow, water is injected into the cylinder at the end of the stroke, thus quickly lowering the temperature to a point where decomposition will not occur. The gases may then be expelled from the cylinder and the nitric oxide allowed to form nitrogen peroxide, which is then abstracted in the usual way. But, since the gases are still hot and still under pressure when the temperature has been lowered to a safe point, they may be expanded in the engine and thus convert a certain portion of their heat into useful work. In other words, by carrying the temperature high enough and then suddenly cooling the gases, nitric acid is secured as a by-product from the gas engine, though, of course, at the expense of a certain loss of heat, due to the cooling.

This loss of heat, which under ordinary operation would be converted into work, represents the energy which is paid for the acid, for, while it does include energy absorbed by the gases which combine, the percentage of gases which take part in the reaction is so small that the absorption of energy thereby is practically negligible. Leaving out other considerations, such as the cost of the water and collecting devices, the cost of the process may be estimated by the cost of this lost work. Figuring on this basis it is estimated that nitric acid, prepared in this way, would cost about one cent per pound, the price of gas being 0.015 cent per thousand British thermal units. This may be compared with the present price of raw nitric acid in Germany, which is about 7.6 cents per pound.

This process of manufacturing nitric acid is interesting, because, while it depends upon a source of cheap energy, it must turn to the mine, and not to the waterfall. Moreover, the nitric acid produced will be of small value compared with that of the mechanical power produced by the engine. In other words, the acid will be the by-product rather than the power, so that to carry on the process commercially will require the disposal of large quantities of mechanical energy. It should be noted that this process puts a further drain on our fuel supplies, though it would undoubtedly be first put into use at the blast furnaces, where gas fuel is now being wasted; so that, in this sense, it offers us a means of saving. Further information regarding this new process will be awaited with interest. If it can be shown to be better than the electrical methods the latter will be forced to the wall, and those who have cheap water-power for sale must turn their attention in other directions.

While on this subject it is interesting to note a suggestion made by one of our contemporaries, that the fixation of atmospheric nitrogen can not be allowed to go on indefinitely for the replenishment of the soil, and that we should pay more attention to saving our wastes, and not call upon the atmosphere for what we need. It has been estimated that in France alone the amount of nitrogen yearly taken from the soil is about 600,000 tons, and not much more than one-half of this is returned to the soil in stable manure. Let us assume, for the purpose of argument, that those countries employing nitrogenous fertilizers use during each year 5,000,000 tons of nitrogen. This seems to be a fairly liberal estimate, judging from the above figure regarding France, and the fact that during 1905 1,500,000 tons of nitrate of soda were employed throughout the world. On this basis it is easily seen that there is no danger of impoverishing the atmosphere, for the atmospheric pressure at sea level corresponds to about eleven pounds of nitrogen per square inch, or, say, 1,500 pounds per square foot, or 20,000,000 tons per square mile. Each square mile of the earth's surface has above it enough nitrogen to supply the entire world for five years, on the basis assumed above; and since the entire surface of the earth is not much short of 200,000,000 square miles, we can go on abstracting nitrogen at this rate for about a million years before reducing the quantity in the atmosphere one-tenth per cent.

EXHAUSTING OUR SUPPLIES.

From time to time, attention is directed to the rate at which we are burning coal and the probable giving out of this necessity, but, until recently, no one pointed out the possible danger that our resources of iron ore are comparatively small. At a recent meeting of the Iron and Steel Institute in London, President R. A. Hedfield said that he had computed that by the year 1950 300,000,000,000 tons of iron ore would be needed

annually. According to trustworthy authorities, only about 10,000,000,000 tons of ore are available in known workable iron fields. By the end of the century, it is probable that the tons of ore which will have been required, allowing for ordinary growth, would be 45,000,000,000, or four and one-half times that now known available.

To offset the exhaustion of our fuel supplies, we have waterfalls and, possibly, heat from the sun. To make up for the lack of iron, we will have to turn to other metals. Since there is no simple metal which we can call to mind at the present moment that is altogether suitable, possibly some alloy will have to be adopted, using perhaps aluminum as a basis.

Assuming that no great revolutionary development in the electrical industries takes place, an assumption which is not warranted, the dynamo builder of 100 years hence will have to do without iron. This would seem to be fatal, but, fortunately, magnetic metals are now known which contain no iron, and these hold out the hope that, even should the worst come, a workable dynamo could be built in which no iron would be used.

By the way, what is the extent of our copper resources, and are they likely to run short during the present century? A lack of copper would be almost as hard to endure in the electrical field as a scarcity of iron.

THE PRESENT STANDING OF THE GAS TURBINE.

To step from the steam turbine to a gas turbine seems at first thought not too dificult, and to offer possibilities of economy in fuel and investment. A closer examination reveals difficulties, both theoretical and practical, though mainly the latter, so that an experimental investigation seems worth while. So far practically no success has been reported. The latest contribution to this subject is an article by Dr. C. E. Lucke in the *Engineering Magazine* for August. Dr. Lucke has studied the possibilities of the gas turbine for some years past, and in this article not only gives the results of certain experiments conducted by himself and the conclusions which he draws therefrom, but he presents, as well, the opinions of a number of other eminent mechanical engineers on the same subject.

The experiments were conducted with a De Laval steam turbine and compressed air, the latter being the most convenient substitute available for the hot gases. This arrangement, of course, has some bearing on the value of the experiment, but the results are nevertheless significant. It was found that the drop in temperature taking place when the gases are expanded in a diverging nozzle is only from four to eighteen per cent of the theoretical, or adiabatic, drop. This drop is influenced by the shape of the nozzle and the speed of the turbine wheel, although the latter seems to act somewhat erratically; but, in any case, the amount of energy which is thus made available is disappointingly low. In fact, the conclusion drawn is that the temperature drop in free expansion with such nozzles indicates very small conversion of heat into work—that is to say, these nozzles are an inefficient means of transforming heat into work. Out of seven opinions given to Dr. Lucke four express disbelief in the success of the gas turbine; two think that there is but little hope for it at the present time, but that eventually we may succeed; and but one takes a hopeful view. Dr. Lucke's summation is that the difficulties encountered by those who have experimented and those that are foreseen by practical men make it almost certain that efforts to produce a successful gas turbine will be fruitless for a long time to come.

THE GYMNOTUS ELECTRICUS AS A SOURCE OF POWER.

An amusing suggestion has appeared recently in the daily papers which, from its novelty, will bear examination. This is nothing more than the idea that we harness for useful purposes the power of the electric eel, or gymnotus electricus, as it is known to naturalists. According to this story, 100 of these eels placed in a zinc tank would give off enough electricity to run an automobile for twenty-four hours. Ten thousand of them distributed about in suitable jars would generate enough power to run a three-car train, and 300,000 would be an ample supply for the largest ocean liner.

If one may work backward from these figures, it would seem that one of these eels has an average power of about one-tenth of a kilowatt, or, say, one-tenth of a horse-power, and this figure would seem to agree fairly with our memory of pictures that used to be given in the old school geographies. We have a very vivid recollection of a picture showing a number of frantic horses driven into a pool of water by a band of Indians and there attacked by these electric eels. In those pictures, there were at least ten eels to every horse.

Figuring on this basis, the gymnotus does not seem to be a very compact generator of electrical energy. These eels grow to considerable size, often five or six feet long, but assuming as a fair figure an average length of three feet and a diameter of two and one-half inches, each eel would occupy a space of about one-eighth of a cubic foot. Our 300,000 eels for the ocean liner would therefore fill a space of twenty feet deep, forty feet wide and sixty feet long solidly with eel flesh, and since each eel would require considerable space for elbow or tail room, there would not be much space left within the vessel for cargo. Moreover, since these eels only constitute the generating part of the equipment, space would have to be found for the motors. It would seem to be a better plan to break the eels to the bridle and teach them to tow the vessel, using them thus as motors rather than generators. This would save all space within the vessel for cargo. It would save the motors and propellers, and in these two respects alone would largely offset any smaller rating we might have to give the gymnotus when employed as a motor rather than as a generator. Moreover, if more power were needed, more eels could be hitched up, and by making the traces long enough they could probably forage while at work, thus saving the vessel the expense of feeding them.

The conditions, unfortunately, are not so favorable for their use on land, for the 5,000 eels estimated to be necessary to run an interurban car would fill a space of 600 cubic feet without allowing any room for wriggling. It is interesting to note that these eels are capable of giving a most terrible shock. The voltage generated in their organs is therefore undoubtedly high, but the quantity involved in the discharge is probably small. Moreover, it seems to be quickly exhausted. The eel is capable of a violent, but short-lived, action.

THE ADVANCE OF SCIENCE.[1]

BY E. RAY LANKESTER.

If I venture on the present occasion to say a few words as to the great features in the progress of our knowledge of Nature during the last twenty-five years, it will be readily understood that the mere volume of new knowledge to be surveyed has become so vast that a full and detailed statement such as that which Lord Avebury placed before the association at its jubilee is no longer possible in a single address delivered from the president's chair.

In attempting to give an outline of the advancement of science in the past twenty-five years I think it is necessary to distinguish two main kinds of advancement, both of which our founders had in view. Francis Bacon gave the title "Advancement of Learning" to that book in which he explained not merely the methods by which the increase of knowledge was possible, but advocated the promotion of knowledge to a new and influential position in the organization of human society. His purpose, says Dean Church, was "to make knowledge really and intelligently the interest, not of the school or the study or the laboratory only, but of society at large." This is what our founders also intended by their use of the word "advancement." So that, in surveying the advancement of science in the past quarter of a century, we of the British Association must ask not only what are the new facts discovered, the new ideas and conceptions which have come into activity, but what progress has science made in becoming really and intelligently the interest of society at large. Is there evidence that there is an increase in the influence of science on the lives of our fellow citizens and in the great affairs of the state? Is there an increased provision for securing the progress of scientific investigation in proportion to the urgency of its need, or an increased disposition to secure the employment of really competent men trained in scientific investigation for the public service?

As one might expect, the progress of the knowledge of Nature (for it is to that rather than to the historical, moral and mental sciences that English-speaking people refer when they use the word "science") has consisted, in the last twenty-five years, in the amplification and fuller verification of principles and theories already accepted, and in the discovery of hitherto unknown things which either have fallen into place in the existing scheme of each science or have necessitated new views, some not very disturbing to existing general conceptions, others of a more startling and, at first sight, disconcerting character. Nevertheless, I think I am justified in saying that, exciting and of entrancing interest as have been some of the discoveries of the past few years, there has been nothing to lead us to conclude that we have been on the wrong path—nothing which is really revolutionary; that is to say, nothing which can not be accepted by an intelligible modification of previous conceptions. There is, in fact, continuity and healthy evolution in the realm of science. While some onlookers have declared to the public that science is at an end, its possibilities exhausted, and but little of the hopes it raised realized, others have asserted, on the contrary, that the new discoveries—such as those relating to the X-rays and to radium—are so inconsistent with previous knowledge as to shake the foundations of science, and to justify a belief in any and every absurdity of an unrestrained fancy. These two reciprocally destructive accusations are due to a class of persons who must be described as the enemies of science. Whether their attitude is due to ignorance or traditions of self-interest, such persons exist; and it is one of the objects of this association to combat their assertions and to demonstrate, by the discoveries announced at its meetings and the consequent orderly building up of the great fabric of "natural knowledge," that Science has not come to the end of her work—has, indeed, only as yet given mankind a foretaste of what she has in store for it—that her methods and her accomplished results are sound and trustworthy, serving with perfect adaptability for the increase of true discovery and the expansion and development of those general conceptions of the processes of Nature at which she aims.

There can be no doubt that the past quarter of a century will stand out forever in human history as that in which new chemical elements, not of an ordinary type, but possessed of truly astounding properties, were made known with extraordinary rapidity and sureness of demonstration. Interesting as the others are, it is the discovery of radioactivity and of the element radium which so far exceeds all others in importance that we may well account it a supreme privilege that it has fallen to our lot to live in the days of this discovery. No single discovery ever made by the searchers of nature even approaches that of radioactivity in respect of the novelty of the properties of matter suddenly revealed by it. A new conception of the structure of matter is necessitated and demonstrated by it, and yet, so far from being destructive and disconcerting, the new conception fits in with, grows out of, and justifies the older schemes which our previous knowledge has formulated.

The delicate electric test for radioactivity has been largely applied in the last few years to all sorts and conditions of matter. As a result it appears that the radium emanation is always present in our atmosphere; that the air in caves is especially rich in it, as are underground waters. Tin-foil, glass, silver, zinc, lead, copper, platinum and aluminum are, all of them, slightly radioactive. The question has been raised whether this widespread radioactivity is due to the wide dissemination of infinitesimal quantities of strong radioactive elements, or whether it is the natural intrinsic property of all matter to emit Becquerel rays. This is the immediate subject of research.

Over and above the more simply appreciable facts of radioactivity, there comes the necessary and difficult enquiry: What does it all mean? What are the Becquerel rays of radioactivity? What must we conceive to be the structure and mechanism of the atoms of radium and allied elements, which can not only pour forth ceaseless streams of intrinsic energy from their own isolated substance, but are perpetually, though in infinitesimal proportions, changing their elemental nature spontaneously, so as to give rise to other atoms which we recognize as other elements?

The kind of conceptions to which these and like discoveries have led the modern physicist in regard to the character of that supposed unbreakable body—the chemical atom—the simple and unaffected friend of our youth—are truly astounding. But I would have you notice that they are not destructive of our previous conceptions, but rather elaborations and developments of the simpler views, introducing the notion of structure and mechanism, agitated and whirling with tremendous force, into what we formerly conceived of as homogeneous or simply built-up particles, the earlier conception being not so much a positive assertion of simplicity as a non-committal expectant formula awaiting the progress of knowledge and the revelations which are now in our hands.

Intimately connected with all the work which has been done in the past twenty-five years in the nature and possible transformations of atoms is the great series of investigations and speculations on astral

[1] Abstracted from the address delivered to the British Association for the Advancement of Science, at York, England, August 1.

chemistry and the development of the chemical elements which we owe to the unremitting labor during this period of Sir Norman Lockyer.

Of great importance has been the whole progress in the theory and practical handling of electrical phenomena of late years. The discovery of the Hertzian waves and their application to wireless telegraphy is a feature of this period, though I may remind some of those who have been impressed by these discoveries that the mere fact of electrical action at a distance is that which hundreds of years ago gave to electricity its name. The power which we have gained of making an instrument oscillate in accordance with a predetermined code of signaling, although detached and a thousand miles distant, does not really lend any new support to the notion that the old-time beliefs of thought transference and second sight are more than illusions based on incomplete observation and imperfect reasoning. For the important factors in such human intercourse—namely, a signaling instrument and a code of signals—have not been discovered, as yet, in the structure of the human body, and have to be consciously devised and manufactured by man in the only examples of thought-transference over long distances at present discovered or laid bare to experiment and observation.

The past quarter of a century has witnessed a great development and application of the methods of producing both very low and very high temperatures. Sir James Dewar, by improved apparatus, has produced liquid hydrogen and a fall of temperature probably reaching to the absolute zero.

In chemistry generally the theoretical tendency guiding a great deal of work has been the completion and verification of the "periodic law" of Mendeléeff; and, on the other hand, the search by physical agents, such as light and electricity, for evidence as to the arrangement of atoms in the molecules of the most diverse chemical compounds. The study of "valency" and its outcome, stereo-chemistry, have been the special lines in which chemistry has advanced. As a matter of course, hundreds, if not thousands, of new chemical bodies have been produced in the laboratory of greater or less theoretical interest. The discovery of the greatest practical and industrial importance in this connection is the production of indigo by synthetical processes, first by laboratory and then by factory methods, so as to compete successfully with the natural product. Von Baeyer and Heumann are the names associated with this remarkable achievement, which has necessarily dislocated a large industry which derived its raw material from British India.

There is no doubt that there has been an immense "revival" in astronomy since 1881; it has developed in every direction. The invention of the "dry plate," which has made it possible to apply photography freely in all astronomical work, is the chief cause of its great expansion. Photography was applied to astronomical work before 1881, but only with difficulty and haltingly. It was the dry plate which made long exposures possible, and thus enabled astronomers to obtain regular records of faintly luminous objects such as nebulæ and star-spectra. Roughly speaking, the number of stars visible to the naked eye may be stated as 8,000; this is raised by the use of our best telescopes to 100,000,000. But the number which can be photographed is indefinite and depends on length of exposure; 1,000,000,000 can certainly be so recorded.

While I have been able, though in a very fragmentary and incomplete way, to indicate the satisfactory and, indeed, the wonderful progress of science since this association last met in York, so far as the making of new knowledge is concerned, I am sorry to say that there is by no means a corresponding "advancement" of science in that signification of the word which implies the increase of the influence of science in the life of the community, the increase of the support given to it, and of the desire to aid in its progress, to discover and then to encourage and reward those who are specially fitted to increase scientific knowledge, and to bring it to bear so as to promote the welfare of the community. I am speaking on a privileged occasion to a body of men who are met together for the advancement of science, and I claim the right to say to them, without offense to the representatives of institutions which I criticize, what is in my mind.

It is, unfortunately, true that the successive political administrators of the affairs of this country, as well as the permanent officials, are altogether unaware to-day, as they were twenty-five years ago, of the vital importance of that knowledge which we call science, and of the urgent need for making use of it in a variety of public affairs. Whole departments of government in which scientific knowledge is the one thing needful are carried on by ministers, permanent secretaries, assistant secretaries and clerks who are wholly ignorant of science, and, naturally enough, dislike it, since it can not be used by them, and is in many instances the condemnation of their official employment. Such officials are, of course, not to be blamed, but rather the general indifference of the public to the unreasonable way in which its interests are neglected.

A difficult feature in treating of this subject is that when one mentions the fact that ministers of state and the officials of the public service are not acquainted with science, and do not even profess to understand its results or their importance, one's statement of this very obvious and notorious fact is apt to be regarded as a personal offense. It is difficult to see wherein the offense lies, for no one seeks to blame these officials for a condition of things which is traditional and frankly admitted.

This is really a very serious matter for the British Association for the Advancement of Science to consider and deal with. We represent a line of activity, a group of professions which are in our opinion of vital importance to the well-being of the nation. We know that those interests which we value so highly are not merely ignored and neglected, but are actually treated as of no account or as non-existent by the old-fashioned class of politicians and administrators. It is not too much to say that there is a natural fear and dislike of scientific knowledge on the part of a large proportion of the persons who are devoid of it, and who would cease to hold, or never have held, the positions of authority or emolument which they now occupy, were scientific knowledge of the matters with which they undertake to deal required of them. This is a thorny subject, and one in which, however much one may endeavor to speak in general terms, it is difficult to avoid causing personal annoyance. Yet it seems to me one which, believing as I do that it is of most urgent importance, it is my duty as your president to press upon the attention of the members of the British Association. Probably an enquiry into and discussion of the neglect of science and the questionable treatment of scientific men by the administrative departments of government would be more appropriate to a committee appointed by the council of the association for this purpose than to the presidential address.

At the same time, I think the present occasion is one on which attention should be drawn in general terms to the fact that science is not gaining "advancement" in public and official consideration and support. The reason is, I think, to be found in the defective education, both at school and university, of our governing class, as well as in a racial dislike among all classes to the establishment and support by public

funds of posts which the average man many not expect to succeed by popular clamor or class privilege in gaining for himself—posts which must be held by men of special training and mental gifts. Whatever the reason for the neglect, the only remedy which we can possibly apply is that of improved education for the upper classes, and the continued effort to spread a knowledge of the results of science and a love for it amongst all members of the community. If members of the British Association took this matter seriously to heart they might do a great deal by insisting that their sons, and their daughters, too, should have reasonable instruction in science both at school and college. They could, by their own initiative and example, do a good deal to put an end to the trifling with classical literature and the absorption in athletics which is considered by too many schoolmasters as that which the British parent desires as the education of his children.

One of the most solid tests of the esteem and value attached to scientific progress by the community is the dedication of large sums of money to scientific purposes by its wealthier members. We know that in the United States such gifts are not infrequent; they are rare in this country. It is, therefore, with especial pleasure that I call your attention to a great gift to science in this country made only a few years ago. Lord Iveagh has endowed the Lister Institute, for researches in connection with the prevention of disease, with no less a sum than a quarter of a million pounds sterling.

Many other noble gifts to scientific research have been made in this country during the period on which we are looking back. Let us be thankful for them, and admire the wise munificence of the donors. But none the less we must refuse to rely entirely on such liberality for the development of the army of science, which has to do battle for mankind against the obvious disabilities and sufferings which afflict us and can be removed by knowledge. The organization and finance of this army should be the care of the state.

It is a fact which many of us who have observed it regret very keenly, that there is to-day a less widespread interest than formerly in natural history and general science, outside the strictly professional arena of the school and the university. The field naturalists among the squires and the country parsons seem nowadays not to be so numerous and active in their delightful pursuits as formerly, and the mechanic's institutes and lecture societies of the days of Lord Brougham have given place, to a very large extent, to musical performances, bioscopes and other entertainments more diverting, but not really more capable of giving pleasure than those in which science was popularized. No doubt the organization and professional character of scientific work are to a large extent the cause of this falling-off in its attraction for amateurs.

In conclusion, I would say a word in reference to the associations of our place of meeting, the birthplace of our society. It seems to me not inappropriate that a society for the advancement of science should have taken its origin under the walls of York Minster, and that the clergy of the great cathedral should have stood by its cradle. It is not true that there is an essential antagonism between the scientific spirit and what is called the religious sentiment. "Religion," says Bishop Creighton, "means the knowledge of our destiny and of the means of fulfilling it." We can say no more and no less of science. Men of science seek, in all reverence, to discover the Almighty, the Everlasting. They claim sympathy and friendship with those who, like themselves, have turned away from the more material struggles of human life, and have set their hearts and minds on the knowledge of the Eternal.

Guayule Rubber Development.

Consul V. L. Duhaime, of Saltillo, writes that the guayule shrub two years ago was not only regarded as worthless, but was considered as a nuisance by the Mexican land owners. In fact, lands thick with this brush, which could have then been bought for a nominal sum, are now difficult to secure, the price being from five to ten times higher.

Many sales of guayule on the ground have been reported at over five times the price at which the land itself was held at previous to this boom. The buying up of this shrub began about the latter part of the year 1904, at $15 Mexican currency per ton. But, owing to the numerous parties anxious to secure quantities large enough to justify them in erecting factories for the extraction of the gum, buyers now find it very difficult to arrange deals. Recently, contracts for large lots have been reported at as high as $100 Mexican currency per ton. For many years guayule was known to contain rubber, but it is only within a short time since that a process has been invented for the extraction of the gum for commercial use. Although the product was of an inferior quality and of little value, it was enough to set chemists and inventors to work on the problem; so much so that many extraction processes are being registered at the Mexican patent office. However, none of the methods have yet attained a degree of perfection, as the known results vary from ten to twelve per cent, whereas the quantity of gum contained in the shrub is known to be approximately eighteen per cent. The quality attained can better be judged by the price realized for the product of the different processes, which varies from twenty-eight to fifty cents, gold, per pound on the New York market. However, men engaged in the new industry are learning to produce a better finished product. A sample lot of such excellent quality, extracted with a process in the experimental stage and not yet patented, brought $1, gold, per pound.

No claim is made that the gum extracted from the guayule will ever take the place of rubber, but it can be made a substitute in many forms of manufacture. This industry has now passed from the experimental to the practical stage, and is destined to become a very important one in northern Mexico, especially in the state of Coahuila. Factories which are already working and those now under construction within a small radius of Saltillo will represent an outlay in buildings and machinery alone of several millions of dollars. Large quantities of the gum extracted are now being exported from this district.

The Rejuvenated Sons of Jove.

The Order of Rejuvenated Sons of Jove will have a meeting at Niagara Falls, N. Y., on Tuesday, September 11, 1906, which promises to be largely attended.

This order, as mentioned some weeks ago in the ELECTRICAL REVIEW, is a secret one which has been organized in the electrical industries. It already has a large membership, which is being rapidly increased.

The forthcoming meeting will be largely attended by the present membership, and an initiation of new members will also be held at that time.

Foreign Trade Opportunities.

The government of Ecuador invites bids for the construction of a railway (steam or electric traction) from Ambato to the river Arajuno. Free importation of materials. Apply, Subsecretario del Ministrio de Obras Publicos, Quito, Ecuador. The file number of the enquiry at the Bureau of Manufactures, Washington, D. C., is 275.

The town of Lujan, Argentina, has decided to erect an electric light plant. The file number of the enquiry is 280.

Municipal Electric Railways at Wellington, New Zealand.

By Frank C. Perkins.

THERE has recently been placed in operation at Wellington, New Zealand, an up-to-date railway power plant and an electric railway system operated by the municipality. This city has a population of 57,663, and during the past year 13,574,223 passengers were carried, with a total car-mileage of 1,471,913. The total length of track is 21.5 miles, a four-foot gauge being used.

The total revenue during the past year was $374,531, while the working expenses were $262,440, the ratio of revenue to working expenses being 70.07 per cent. The working expenses per car-mile were 17.16 cents, and the number of units per car-mile was 1.51. The total number of units used was 2,228,313, and the whole cost per unit was 1.54 cents.

The price of coal per ton employed at this station is $4.25. The total cost of the Wellington Electric Railway system, including the power station, was $1,555,200.

It is maintained that in the movement of municipalization of public works Wellington lays claims to her own fire brigade, water, drainage and tramways systems, and lighting is to be added to the list in the near future. The electric tramways provide a good example of what may be attained in affairs having the direct control of the people. The system has now been running two years, and the following is a brief outline of this system:

Overhead trolley construction is used, and there are over twenty-one miles of single and double track open for traffic. The whole of the city track has been laid on a solid concrete foundation. The rails are of the British standard section No. 2, ninety-five pounds per yard, forty feet long and bonded with No. 0000 stranded copper bonds. The overhead wires are suspended from welded-steel tubular poles, the latter being fitted with artistic bases and scrollwork; the trolley wire is No. 0000 gauge, hard-drawn copper, fixed with sweated ears and flexible suspension.

The accompanying illustration, Fig. 1, shows the interior of the power station, which is situated on reclaimed land near the harbor and close to the new coal wharf in course of erection for the harbor board—a site which has proved of great convenience. It is a handsome structure, built of the best quality pressed brick, relieved with moulded blue Staffordshire bricks. The chimney is the largest in Wellington, being 130 feet high, with an internal diameter of ten feet; thus providing flue capacity for fully 7,000 horsepower, or four times the output of the existing station. The fear of earthquakes, which still visit the city, has made it necessary to build the stack in the most substantial manner. During an earthquake which occurred about twelve months ago the stack was subjected to a severe test and stood it well.

The boiler house, fronting on Victoria street, is a spacious room, seventy feet by eighty-one feet, lofty and well lit and with ample windows and skylights. There are at present three boilers, of the

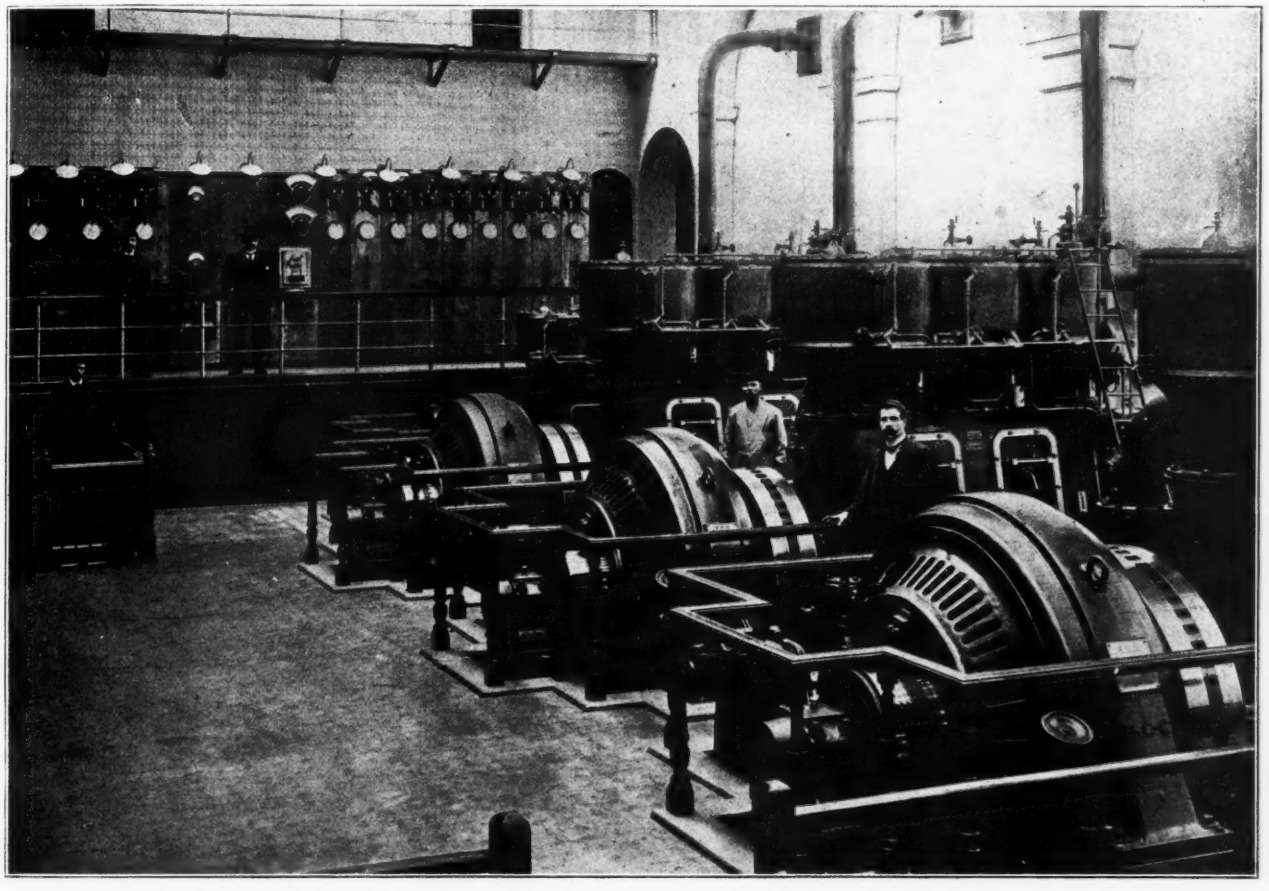


FIG. 1.—INTERIOR VIEW OF POWER STATION, CORPORATION TRAMWAYS, WELLINGTON, NEW ZEALAND.

Lancashire type, eight feet by thirty feet, working at a pressure of 160 pounds per square inch, made by Daniel Adamson & Son, to withstand a test pressure of 320 pounds per square inch. This was necessary in order to conform with the government regulations, which provide for a test at double the working pressure. Space has also been provided for four more boilers, two of which are now on order. The labor of stoking has been brought to a minimum because the coal, once tipped into the bunker, is fed by means of a series of motor-driven conveyers, made by the New Conveyer Company, into the hoppers of the mechanical stokers. The coal is forced with the simple ram action below the fire line, and as the fresh coal rises it is brought to the coking stage at which the gases are liberated to pass upward through the fire, thus ensuring utilization of the maximum amount of calorific value in the coal. Forced draught is provided by means of motor-driven rotary blower fans of the Cyclone Fan Company's manufacture, which maintain a high furnace temperature. Two Weir gun-metal pumps, with seven-inch-diameter piston, nine and one-half-inch cylinder, twenty-one-inch stroke, represent the boiler feed plant, each with a capacity of 4,000 gallons per hour. The feed-water passes through a large Green economizer having 640 iron pipes set vertically in the flue. The pipes are nine feet long and are provided with scrapers worked by a small enclosed type motor. An auxiliary by-pass flue is also provided as a standby during overhaul. The flues are ten feet by six feet. There are two steam mains from each boiler, one leading direct to a ten-inch range, the other to a Bolton superheater with a heating surface of 190 square feet, set at the end of each boiler. Suitable valves of the Hopkinson pattern are provided, admitting of the utmost flexibility of manipulation.

The steam superheat is about 100 degrees Fahrenheit. Geipel steam traps, placed in suitable positions, prevent any water likely to condense in the pipes from getting across to the engines. The type of engine used is the Belliss & Morcom triple-expansion, high-speed, self-lubricating machine, direct-coupled to Electric Construction Company six-pole direct-current generators. Four units are installed, one of 250 horse-power and three of 500 horse-power. The foundations are in place, however, for two additional machines, one of which, of 1,000-horse-power capacity, is under order.

For municipal lighting the 250-horse-power set is used, supplying current at 220 volts. This set, however, is also used from midnight to morning as a traction unit, delivering 550 volts, to keep the current on the lines for the ordinary work of cleaning and repairing the cars, etc. Of the three 500-horse-power sets one is always standing by, while the other two take the traction load all day. The speed of the small set is 500 revolutions per minute, and of the others 375 revolutions per minute. There are now being installed in the power station two more boilers of the same size and class and a 1,000-horse-power Belliss & Morcom engine direct-coupled to an Electric Construction Company dynamo. There are also two small motor-generators.

The switchboard is set on a raised platform at the end of the engine room, and is composed of handsome gray-blue mar-

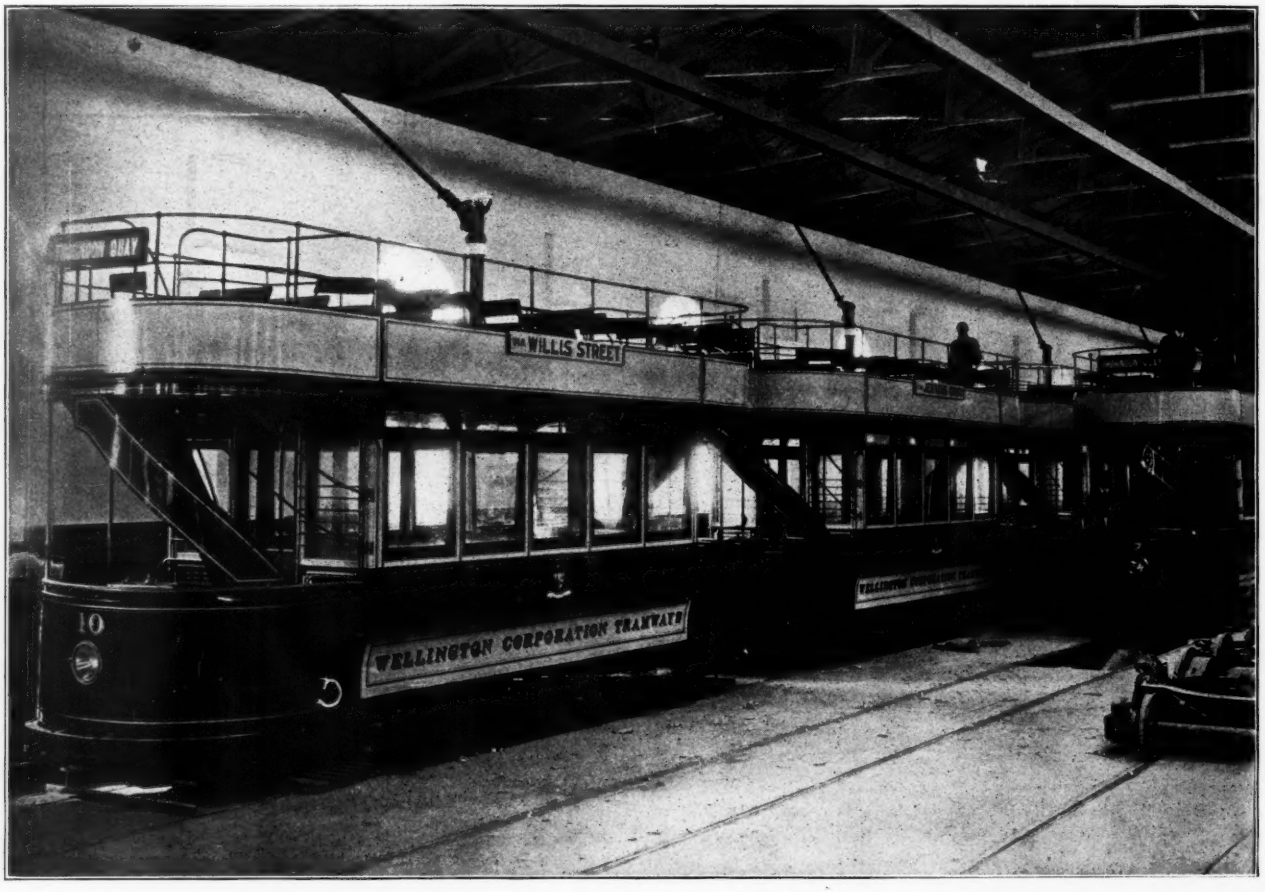


FIG. 2.—CAR EQUIPMENT OF CORPORATION TRAMWAYS, WELLINGTON, NEW ZEALAND.

ble. There are four machines, one Board of Trade, one summation and nine feeder panels all provided with the necessary indicating and integrating instruments, switches and circuit-breakers. The engine room is traversed by a motor-driven overhead crane, capable of lifting fifteen tons, made by Jessop & Appleby.

As noted in the accompanying illustration, the general appearance of the engine room, which is eighty-five feet by thirty-five feet, is very neat and attractive. The walls are sheathed with Wunderlich stamped-steel facings and painted in green shades and cream, while the floor is suitably laid out with terra-cotta tiles.

The condensing plant, which is of a type lately finding great favor, is particularly adapted to the requirements of the power station, situated close to the harbor, with a plentiful supply of sea water for condensing purposes. The plant consists of three motor-driven centrifugal pumps which pump the sea water from a well fed by a large culvert into an overhead tank. The water then gravitates to jet condensers on the "Korting" ejector principle fixed to each individual engine. An average vacuum of twenty-seven inches is maintained. Over the pump room are the offices of the chief engineer, the lines superintendent and also the testing laboratory.

The engines are now working on a very small coal consumption and require a minimum of attention. This fact, together with the economy of management of the works, results in the production of power at well under one cent per unit.

The accompanying illustrations, Figs. 2 and 3, show the car shed, situated at the southern end of Newtown, which is a fine building in picked brick, 384 feet long by 101 feet wide; the steel-trussed roof being divided into two bays provided with ample skylights. Forty feet of one end of the shed is used as a workshop, paintshop and smithy. The workshop is provided with up-to-date motor-driven machine tools, including a heavy turning lathe, wheel lathe and press. It is provided with eight tracks and has large sliding entrance doors.

The rolling stock consists of forty-six cars, and comprises box cars, double-deck cars, combination cars, side-door cars and the open-sided Hong Kong type—all of which are painted in Indian red picked out with pale canary-yellow. They look well and are in every way suitable for their particular class of work. All the cars, with the exception of the combination type, are mounted on Brill trucks with two General Electric motors of twenty-five horse-power each.

A new type of trolley head (Figs. 4 and 5) designed by Messrs. Holmes and Allen, about to be used, is a distinct departure from the usual design and embodies several novel features introduced with the aim of preventing accidents now possible with the overhead system.

In the normal riding position the head resembles closely those now used on all side-running systems. If the wheel jumps, however, a concealed spring causes the head to collapse and automatically rings a bell placed close to the motorman. In this position it is impossible for accidents to happen, since the head can not foul and catch the overhead span wires. The usual pull on the rope necessary to replace the wheel on the wire resets the head.

It is claimed that the spring has a

FIG. 3.—CAR BARN OF THE CORPORATION TRAMWAYS, WELLINGTON, NEW ZEALAND.

double importance, since, due to its cushioning action, the wheel is actually prevented from leaving the wire.

It is stated that since the completion of the city tracks, a year ago, considerable progress has been made in extending the lines to Greater Wellington. The Island Bay section is now open right down to the water. Kilbirnie tunnel (one-quarter mile long) is in the hands of the contractor,

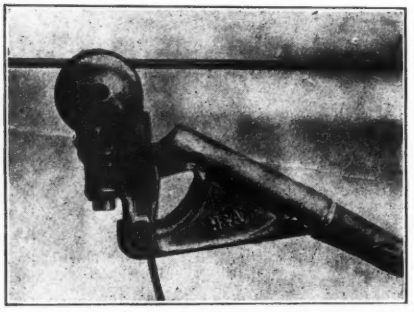


FIG. 4.—NEW FORM OF TROLLEY HEAD, WELLINGTON CORPORATION TRAMWAYS.

and is steadily moving on to completion. As this work is nearing completion a start will be made with the track on each side of the tunnel. The full length of this extension is to be one and three-quarter miles and in the near future will be continued for a distance of two miles out to Seatoun and Miramar.

It is said that the Brooklyn section is now completed. The latter work has entailed heavy cutting and embankments. This section will be one-twelfth mile in length.

On account of the fact that traffic on these suburban extensions will not be as

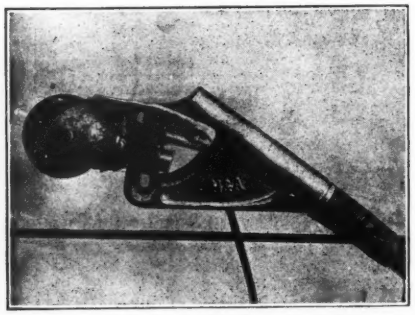


FIG. 5.—NEW FORM OF TROLLEY HEAD, WELLINGTON CORPORATION TRAMWAYS.

heavy as that dealt with in the city, sleeper construction has been adopted. The chief objection to this type of construction—namely, the springing at joints—has been nullified by using the same anchor joints as have been used on the city tracks.

The Kilbirnie line will eventually be extended to Miramar and Seatoun. This will entail two and three-quarter miles of single track and is mostly on the level skirting the harbor edge; a short tunnel, however, will be necessary before Seatoun is reached.

The extension to Karori is about two miles in length. It will wind up a tortuous road, passing through a short road tunnel before the cemetery gates are reached, which will be the terminus for the next few years.

The Wadestown borough council has investigated proposals to determine the best way to serve that borough with a tramway. It has proved a difficult task and had called forth proposals of all descriptions, including a cable system. This district is about 600 feet above sea level, and if electric tramways are adapted some heavy grades will have to be negotiated.

All these schemes are to be run in conjunction with the city tramways—the same gauge and characteristics being adhered to.

This tramway system for its size deals with a very large passenger traffic, the volume of which is steadily on the increase, carrying annually about 15,000,000 passengers, while a glance at the returns of British systems will show that this is 100 per cent better than that accomplished in any town of similar size.

The permanent way and overhead construction were carried out by MacArtney, McElroy & Company, of London, and the plant was installed by the Electric Construction Company, of Wolverhampton, England.

The future before the tramways is full of questions of suburban extensions. The surrounding boroughs have all passed resolutions assenting to the proposals formulated by their governing bodies. The roads will be built at the borough's expense by the Wellington Corporation, who will also supply power and cars at a fixed charge per car-mile.

Telephone and Telegraph.

A Western Union official, says the *Wall Street Journal,* recently stated that the rapid development of the telephone industry was cutting into the business of the telegraphic companies, particularly the Western Union. So far as exchange service is concerned, the Western Union and the American Telephone sub-companies can not be considered. In the long-distance service of the American Telephone Company and the toll service of the thirty-four sub-companies, the two industries are more or less competitors, and an analysis of the development of these two competing lines of business in the past ten years reveals the truth of the admission made by the Western Union official.

In the ten years ended December 31 last, the toll and long-distance service of the American Telephone Company and its sub-companies increased from $4,000,000 gross to $30,000,000, a gain of $26,000,000, or 650 per cent. In the same period the gross business of the Western Union increased only $6,815,626 or 30.6 per cent. During these ten years, however, the Western Union has had to meet the sharp rivalry of the Postal Telegraph Company, practically all of the growth of which has been crowded into the past five or six years and the bulk of which has been at the expense of the Western Union.

The following table shows the rapid growth in the toll-line telephone business:

Gross.	Toll and Long Distance.	Western Union.
1905	$30,000,000	$29,033,635
1895	4,000,000	22,218,019
Increase	26,000,000	6,815,626
Per cent increase	650	30.6

In 1895 the number of telephone toll and long-distance calls per annum was three and one-half times smaller than the total number of messages handled annually by the Western Union. To-day the tables have been reversed and during 1905 the number of toll calls was nearly double the messages handled by the Western Union. The following table outlines this growth:

No. Calls.	Toll and Long Distance.	Western Union.
1905	118,522,000	67,477,320
1895	16,400,000	58,307,315
Increase	102,122,000	9,170,005
Per cent increase.	622.5	15.7

Further evidence of the growth in the capacity of the telephone toll business to compete with the Western Union is found in the rapid increase in toll wire mileage. In 1905 for the first time in the history of the telephone industry, the number of mile of toll wire passed the wire mileage of the Western Union. The expansion of the past ten years is shown as follows:

Miles Wire.	Toll and Long Distance.	Western Union.
1905	1,265,236	1,184,557
1895	305,938	802,651
Increase	959,298	381,906
Per cent increase	313	47

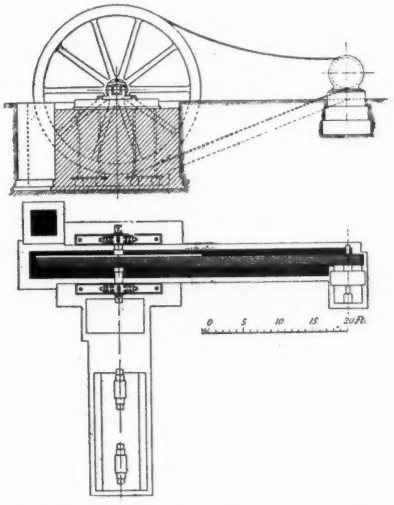
The gross receipts per message have shown little fluctuation in the case of either the telephone or telegraph services. The gross per toll call for 1905 was 25.3 cents and per telegraph message, eliminating "dead-heads," was 31.6 cents, an increase of about one cent per message in ten years for each service.

The record indicated sufficiently marked to show a steady trend in public sentiment toward the more extended use of the telephone for purposes for which the telegraph only was considered available a few years ago.

An Electrically Driven Tin-Plate Mill.

The few particulars respecting electrically driven tin-plate mills which follow were given in a paper entitled "The Manufacture of Tin Plates," which was read by R. B. Thomas before the Institution of Mechanical Engineers of Great Britain during the recent meeting at Cardiff:

The figure illustrates a tin-plate mill recently put down by the Redbrook Tin Plate Company, Tynewydd works, Wales. The motor is a Siemens Brothers, three-phase induction motor, which takes current from the South Wales Electrical Power Distribution Company's system at 2,200 volts pressure, and a frequency of twenty-five cycles. It is rated at 100 brake-horse-power and has a synchronous speed of 250 revolutions per minute. The load in tin-plate rolling is very variable. Siemens Brothers estimate that, in this



ELECTRICALLY DRIVEN TIN-PLATE MILL.

case, the maximum load reaches two and one-quarter times the normal; that is, when the piece passes into the rolls. At this overload, they state, the motor shows no tendency to fall out of step or to overheat.

The Redbrook company has also put in a cold-roll drive on the same lines. Five pairs of cold rolls are driven through rope gearing, the motor being of the same type and speed, but rated at 125 brake-horse-power. This is stated to be giving every satisfaction.

Switchboard readings for these two motors give the following results: in the case of the mill, on the first and last heat the maximum reading is 180 horse-power and on the second, third and fourth heats the maximum reading gives 120 horse-power to 150 horse-power; in the case of the cold rolls, starting up in the morning, the maximum reading gives 280 horse-power and the normal reading for the five pairs of cold rolls after starting up gives ninety horse-power.

A still more extensive electrical drive for cold rolls has been put in by Messrs. Lewis, of Gorseinon.

For illuminating, electric light is in general use in the tin-plate works in South Wales. The Melingriffith Tin Plate Company, and some others, use electric power to drive the tin house, fitting shop and other light work, and probably for this purpose it will come into general use in the future.

Electricity in Mines.

A very great development has taken place during the past two years in electrical machinery and apparatus for working colliery plant, says *Nature*. Manufacturers seem at last to have realized that machines and accessories must be adapted and made to suit the conditions existing in collieries, and that the collieries can not be adapted to suit their standard machines. Consequently, in the colliery exhibition which has just taken place in London, the result of experience in colliery work was clearly put before us in entirely new designs of motors and switch gear specially adapted for this work.

The details of colliery requirements have been most carefully studied and gone into, and the designs prove the tremendous development that has taken place. Whereas a few years ago contractors simply attached their standard machine to a haulage gear or coal cutter, and supplied the ordinary switch gear as for everyday use, to-day we find that it is the general rule for motors to be designed and built for the particular work for which they are intended, and to be made part and parcel of the machine they have to drive. The same applies to the switch gear, and a large supply of different forms of specially enclosed switches for use in very fiery mines proves how thoroughly the manufacturers have interested themselves in the matter.

The automatic and electrical devices for regulating and signaling in connection with electrically driven winding engines were quite the most interesting and valuable introduction in this year's exhibition, and the fact that by far the greater number of coal cutters and drills which were exhibited were fitted with electric motors should go far to prove that electricity is fighting its way successfully against the older established methods of colliery procedure.

Other arrangements of colliery machinery showing the adaptability of electric motors were well represented by motor-driven pumps, fans, hoists, heading machines and elevators, and among interesting signs of the times were the electrically driven air-compressors.

This development in colliery work is quite in keeping with the expansion of the use of electricity for power purposes which is taking place at the present time. The many power schemes now in hand or being brought before Parliament also show that, although it has been a long time coming, electricity as a motive power for general use may now be said to have "arrived."

London Underground Electric Railways.

Considerable progress has now been made with the new tube railways under construction and the extensions to the existing lines. The Great Northern, Piccadilly & Brompton Railway is approaching completion and it is expected to be ready for opening by the end of the present year. The large accumulator locomotives used for hauling material and construction trains have for some months been a familiar sight along the above-ground portion of the route between West Kensington and Hammersmith, and many of the station buildings are practically complete. The Charing Cross, Euston & Hampstead Railway is also in a forward condition. The tunnels are through almost entirely, the rails are laid and a large portion of cables have been already put in. The dimensions of the tunnels and details of the track work are in all respects similar to those of the Baker Street & Waterloo line, except that the running rails are being laid in forty-five-foot lengths as against the thirty-five-foot lengths of the Baker Street & Waterloo. A large depot, including car shed, stores and repair shops, has been erected at Golder's Green, Hampstead, where the line emerges to the surface, and where one of the largest substations is situated. Construction of the Edgware & Hampstead Railway and of the Edgware & Watford Railway, both of which are authorized and which will form extensions of the Charing Cross, Euston & Hampstead line, has not yet been commenced. The extension of the City & South London Railway to Euston is expected to be ready for traffic in about three months. The two remaining new London electric railways authorized—*viz.*, the North-West London and the North-East London lines, have not yet been commenced.—*Electrician (London), July 27.*

Test of a Small Gasolene Electric Light Plant.

The adaptability of the small gasolene engine to drive an electric generator for lighting purposes has raised a number of enquiries among farmers and others as to the practicability of lighting their residences, barns and other buildings with the electric incandescent light, produced by an electric generator driven by a gasolene engine, the engine being used for other purposes also.

With the above enquiry in view a test was made of a small unit, consisting of a two-horse-power, vertical, Fairbanks-Morse Company's throttling-governor gasolene engine, belted to their one-and-one-half-kilowatt electric generator. This unit was installed in the electrical engineering laboratory of the Kansas State Agricultural College, and the data obtained by Messrs. Dow, Carlson and Stoddard, senior students in the electrical engineering course. The outfit was set up and the test started about March 23, and was continued up to June 5. The tests were made for five and ten-hour continuous runs.

The generator was first calibrated or tested for efficiency, which at full load was found to be seventy-one per cent.

The gasolene tank from which gasolene was supplied to the engine was carefully calibrated or gauged, so that at any time the amount of gasolene consumed for a given period could be easily read. Readings were taken immediately after starting and stopping.

The average amount of gasolene consumed for a number of five and ten-hour runs was 1.35 quarts per hour on a full load of eighteen sixteen-candle-power, 110-volt incandescent lamps, which represents a two-horse-power output for the engine. The amount of gasolene consumed per hour when running light, *i. e.*, with no load on the engine, was 0.85 quart. The above figures are based on a grade of gasolene known as "Crown gasolene." Assuming this to cost fifteen cents per gallon, the cost per kilowatt-hour is approximately five cents. (Seven hundred and forty-six watts equals one horse-power, 1,000 watts equals one kilowatt.)

A higher grade of gasolene was tested, but with no better results as to cost.

The average results are shown by the following tabulated data:

Time.	Generator.			Gasolene Qts. per Hr.	Engine H. P.	Cost H. P.-Hour.	Cost K. W.-Hour.
	Volts.	Amp.	Watts.				
10 hours.....	110	9.3	1,023	1.35	2	$0.0253	$0.0495

The generator was operated at its rated speed, 1,850 revolutions per minute, and a test made for voltage regulation. This was done by means of a voltmeter placed across the generator terminals and its fluctuations observed.

With any given load the voltage did not vary to exceed one volt. This is less than one per cent when operating the lamps at their normal voltage, 110 volts. This variation is more rapid than in the case of a steam-driven unit with equal variation, and hence is likely to be more noticeable. A comparative test, however, was made to determine the difference between the incandescent lamps operated by the College steam-driven generator and those operated by the gasolene engine, with the result that little difference could be detected—the casual observer would not distinguish between them.

No attention was required by either the engine or generator after starting on a ten-hour run except to supply water to the cooling tank. The highest temperature of the water in the cooling tank was 185 degrees Fahrenheit.—B. F. EYER, in the *Industrialist.*

SUBURBAN ELECTRIFICATION AT BOSTON.

BY HOWARD S. KNOWLTON.

The statement of Vice-President Van Etten that there is no likelihood of the installation of electricity on the suburban service of the Boston & Albany in the near future is not surprising in view of the conservative attitude which has long characterized the officials of the steam roads terminating at the Hub, in regard to electrification. Then, too, the conditions prevailing in the suburban service between the environs of Boston and the city proper are, on the whole, about as satisfactory as could be expected under the régime of the steam locomotive. Trains are frequent, especially at morning and night; there are numerous expresses to important suburbs on the main lines; commutation rates do not greatly exceed one cent per mile, and the rolling stock is generally comfortable if not always attractive in appearance. Some 835 trains per day are handled in and out of the South Station alone, exclusive of dead mileage in the terminal and its yard.

Ten years ago it is understood that the completion of new electric lines between Boston and the Newton district cut down the passenger traffic on the suburban steam trains of the Boston & Albany Railroad about twenty-five per cent. The latter company has now not only recovered the twenty-five per cent of lost revenue, but has increased its revenues ten per cent above that of 1896. It therefore feels it unnecessary to expend $2,000,000 for the electrification of the Newton circuit line, although the vast terminal electrifications at New York are being carefully watched with an eye toward securing data applicable in some degree to Boston in the future.

Despite the obvious wisdom of drawing every possible lesson from the larger work at New York, it is certainly difficult to cite a suburban service outside the metropolis which offers better opportunity for electrification or a better field for its advantages than the Newton circuit line of the Boston & Albany road. Here we have a double-track loop about twenty miles in length, operating in some of the most beautiful residential districts in the world, stations seldom much over a mile apart, population steadily growing, practically no sharp curves or heavy grades in the track layout, and a volume of train movements each twenty-four hours which could be immeasurably better handled by electricity than by steam, all things considered. Every mile of the circuit is private right of way; there are no long tunnels, and the Charles river winds in its course most accommodatingly as regards desirable power-station sites. There are, of course, difficulties in the South Station yard and train shed which are not to be lightly swept aside, but it is likely that heavy electric railway engineering is equal to any problem of equipment which would be likely to present itself at Boston. The electrification of the Newton circuit line would unquestionably stimulate traffic and be warmly received by the public in Greater Boston if it were carried out, and, even though it be delayed for some years, the experience of the electrified roads at New York, including the New Haven's tentative and actual plans for New England, is likely to lead to an irresistible demand for the improved service in other large urban communities. The tendency of the times is away from the steam locomotive in great cities, and the problems of electrification are no longer as formidable as they were even two or three years ago.

SOME NOTES ON THE MECHANICAL DESIGN OF ELECTRICAL GENERATORS.[1]

BY R. LIVINGSTONE.

It is frequently stated that in many cases theory does not agree with practice. I do not altogether hold with this statement, but at the same time I have no doubt that many theories are of very little use in practical work; either because the theories are not far enough advanced, or because we have not sufficient knowledge of the practical conditions to be able to apply them accurately. For instance, in some forms of castings, subjected to a bending stress, we may be able to calculate the bending stress very accurately, yet find if we use a factor of safety of four or five, that the casting fails when put to use; failure being due to high initial contraction stresses. This certainly does not prove that the theory of bending was at fault, but it does show that experience is of the utmost value in its application. It is not sufficient to proportion a casting to suit its working stresses only: great care must be taken in design to avoid contraction stresses, and when it is impossible to do away altogether with them, to use such high factors of safety that the risk of failure will be small. It is certainly a mistake to depend solely on calculation for the design of electrical generators, but at the same time it is a much greater mistake to proportion the various parts of a machine only by their appearance or by intuition, as many draughtsmen do. The ideal designer is one who can judge correctly the relation between the calculated

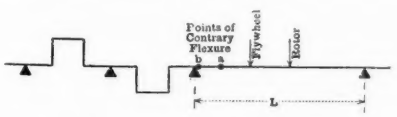


FIG. 1.—MECHANICAL DESIGN OF GENERATORS.

stresses and the actual stresses. In a few cases the calculated will be the actual stresses, and very low factors of safety can be used, but in the majority of cases the calculated will only be in proportion to the actual stresses and proportionately higher factors of safety must be used.

The following notes on the mechanical design of generators mostly relate to direct-coupled generators, and it is hoped they will serve as a safe guide in the design of such machines.

Shafts—In shafts for direct-connected generators the stresses due to bending are so high in comparison with the torsional stresses that the latter may be neglected. The twisting moment, taking the average of a number of direct-coupled machines, may be approximately one-fourth of the bending moments. Then substituting this value in the equation for the torsional equivalent of the combined moments, $B + \sqrt{B^2 + T^2}$ (where B = bending moment and T = torsional moment), we get a value of 2.03 B instead of 2 B, when T is neglected, or an error of 1.5 per cent. This is clearly negligible when we consider that the error in calculating the weight of the rotor and flywheel might be as much as five per cent. Although the shaft is really a continuation of the engine shaft, and the point of contrary flexure changes from *a* to *b* (Fig. 1) once every revolution, due to the thrust from the piston being downward during one-half of a revolution and upward during the succeeding half, we are quite justified in assuming that the point of contrary flexure may be at the centre line of the engine bearing when calculating the generator shaft, and may calculate the shaft as a simple beam supported on two bearings, the engine bearing at one end and the outboard generator bearing at the other. The stresses obtained in this manner are due to dead loads only and a sufficiently high factor of safety should be used to take care of the increase of stress due to the eccentricity or out of balance of the rotor. As the stresses are alternating, the breaking load is a load which gives a much lower stress than the actual tensile strength of the material. A few results of tests by various authorities are shown plotted in **Fig.** 2. It is unfortunate that in the records of those tests the periodicities of alternation have not been given, as this is of even more importance than the number of alternations of stress before fracture. Also the chemical composition of the material, particularly the percentage of phosphorus, would have been a valuable addition to the data published. However, the stress in the shaft may, without fear of fracture, run up to one-quarter of the breaking stress given by an alternating test if the deflection of the shaft is not too high.

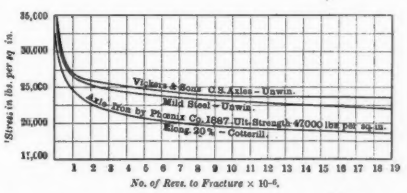

35,000
30,000
25,000
20,000
17,000
Stress in lbs. per sq. in.
Vickers & Sons' U.S. Axles - Unwin.
Mild Steel - Unwin.
Axle iron by Phœnix Co. 1887. Ult. Strength 47000 lbs. per sq. in. Elong. 20 % - Cotterill.
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
No. of Revs. to Fracture × 10⁻⁶.

FIG. 2.—MECHANICAL DESIGN OF GENERATORS.

The unknown stresses are to such a large extent dependent on the stiffness of the shaft that the allowable deflection is of even more importance than the calculated stress in the material when determining the shaft diameter. This is especially the case in machines which have an unbalanced pull when the rotor is displaced from its central position. It is evident that in such machines the variations of deflection due to small out-of-balance forces cause unbalanced magnetic pulls, which increase the variations of deflection considerably and cause unsatisfactory running of the machine. For this reason the deflection should not exceed a proper proportion of the air-gap. A proportion which is found to give very satisfactory results in practice is ten per cent of the air-gap, in machines which have an unbalanced magnetic pull on the rotor when the rotor is displaced. Equalizing rings on direct-current armatures are said to do away to a great extent with the unbalanced magnetic pull, and on such machines a slightly higher shaft deflection can be allowed, though in no case should the deflection exceed twenty per cent of the air-gap.

Taking the average of a large number of generators, I find that the distribution of load on the generator shaft is such that

$$\delta = \frac{W L^3}{84.5 d^4 \times 10^6} \qquad (1)$$

when the shaft is proportioned to give a

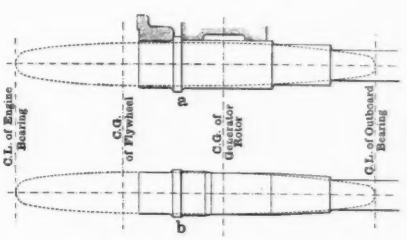


FIG. 3.—MECHANICAL DESIGN OF GENERATORS.

uniform stress throughout, where δ = deflection in inches at the centre line of armature or field, W = weight of flywheel, armature and commutator, shaft and unbalanced magnetic pull, L = length of span in inches (Fig. 1), and *d* = diameter of shaft at centre line of armature in inches.

Now, if the deflection is limited to ten per cent of the air-gap, taking average air-gaps will give the following allowable deflections:

0.0250 for generators of 100-kilowatt to 300-kilowatt capacity.
0.0375 for generators of 300-kilowatt to 750-kilowatt capacity.
0.0500 for generators of 750-kilowatt upward capacity.

Then, taking formula (1) and inserting

[1] Paper read before the Dick, Kerr Engineering Society. Abstracted in the *Electrician*, London, July 27.

the values of allowable deflection, we obtain the diameter of shaft:

$$d = \sqrt[4]{\frac{W L^3}{38.0}}$$ for generators 100 kilowatts to 300 kilowatts (2)

$$d = \sqrt[4]{\frac{W L^3}{42.2}}$$ for generators 300 kilowatts to 750 kilowatts (3)

and $$d = \sqrt[4]{\frac{W L^3}{45.4}}$$ for generators 750 kilowatts upward. (4)

The above will give the diameter of shaft which should be used in ordinary cases—that is, moderate speed machines which have an unbalanced magnetic pull when the rotor is displaced. The value of W should include the unbalanced magnetic pull when the rotor is displaced by an amount equal to the allowable shaft deflection. For high-speed machines the allowable deflection should be less than ten per cent of the air-gap, and for low-speed machines might be as high as twenty per cent. No definite rule can be put down, as each particular case must be decided on its merits. The following short table may serve as a guide for the deflection which can be allowed:

	With Unbalanced Pull. Per Cent of Air-Gap.	Without Unbalanced Pull. Per Cent of Air-Gap.
Low speed, 50 to 150 revolutions per minute.....	12	20
Ordinary speed, 150 to 650 revolutions per minute..	10	15
High speed, 650 to 1,000 revolutions per minute..	8	10

When the diameter at the centre line of the rotor has been obtained by this method the shaft should be checked to see that the stresses give a factor of safety of not less than four, and the shaft proportioned for a uniform bending stress throughout.

Any sudden change in diameter is bad, as where a shaft drops from one diameter to another, there is a break in the continuity of the metal fibre, and so a point is provided where fracture can commence. In fact, it is possible to weaken a shaft by increasing its diameter at a particular point above what is necessary for uniform stress. Changes in diameter then should be made as gradual as possible and the actual longitudinal section should follow as closely as possible the section calculated for uniform strength. Fillets should not be used if possible as changes in diameter are better made with tapers. Fig. 3 will help to illustrate my meaning. The dotted lines show the theoretical section, *a* shows an incorrect shaft and *b* shows the correct section.

THE TWELFTH ANNUAL CONVENTION OF THE OHIO ELECTRIC LIGHT ASSOCIATION.

HOTEL VICTORY, PUT-IN-BAY ISLAND, OHIO, AUGUST 21, 22 AND 23.

The twelfth annual convention of the Ohio Electric Light Association will be held at the Hotel Victory, Put-in-Bay Island, Ohio, August 21, 22 and 23. A fine programme has been arranged, the second day's session being devoted largely to the commercial end of central station work.

An elaborate programme of entertainment is being prepared, particular efforts being made to render these issues of especial enjoyment to the ladies. Through the courtesy of the manufacturers a number of valuable prizes will be awarded to the successful contestants in the games which will be conducted.

The following programme has been announced:

TUESDAY, AUGUST 21.

Meeting of all committees, 1.00 P. M.

FIRST SESSION, 1.30 P. M.

Address of acting-president, W. E. Russell, Massillon, Ohio.

Papers—"High-Efficiency Lighting Units in Ohio by Central Station Men," A. N. Cope, Public Service Company, Columbus, Ohio; T. D. Buckwell and J. W. Gilmartin, Toledo Railway and Light Company, Toledo, Ohio; C. C. Collins, Columbus Railway and Light Company, Columbus, Ohio.

Papers—"New Lamps and New Opportunities," F. W. Wilcox, General Electric Company, Harrison, N. J.

General talk on Nernst lamps, Max Harris, Nernst Lamp Company, Pittsburg, Pa.

Entertainment—Automobile ride around the island and visit to the caves for the ladies; prize contests and bathing; evening band concert and reception.

WEDNESDAY, AUGUST 22—FIRST SESSION, 9.30 A. M.

"Best Methods of Increasing Business"—Papers—"As Applied to Small Cities and Towns," Samuel M. Rust, Greenville Electric Light and Power Company, Greenville, Ohio. "As Applied to Cities," W. C. Anderson, Canton Light, Heat and Power Company, Canton, Ohio. "As Applied to Large Cities," Frank M. Tait, Dayton Lighting Company, Dayton, Ohio.

"Successful Ways of Increasing Business"—Papers—J. Kermode, Cleveland Illuminating Company, Cleveland, Ohio; J. H. Maxon, Gallipolis Light and Coke Company, Gallipolis, Ohio; D. W. Low, Alliance Gas and Electric Company, Alliance, Ohio; E. H. Beil, Youngstown Consolidated Gas and Electric Company, Youngstown, Ohio; M. E. Turner, Cleveland Illuminating Company, Cleveland, Ohio.

SECOND SESSION, 2.00 P. M.

Papers—"Gas Engines in Competition with Electric Motors," Wm. Wolls, Columbus Railway and Light Company, Columbus, Ohio.

"Advertising and New-Business Getting," Chas. A. Parker, Detroit, Mich.

"Wiring of a $3,500 Residence Scientifically Lighted," J. R. Cravath, Chicago, Ill.

"Series Luminous Arc Rectifier Systems," N. R. Birge, Schenectady, N. Y.

EVENING.

Rejuvenation of Sons of Jove.

Entertainments—Card party for ladies for prizes, forenoon; bowling contest and croquet for prizes; bathing and trolley ride; grand ball, evening.

THURSDAY, AUGUST 23—FIRST SESSION, 9.30 A. M.

Papers—"Report of Committee on Cost Determination," E. J. Bechtel, Toledo Railway and Light Company, Toledo, Ohio.

"Report of Committee on Publicity," B. S. Young, Ada Water, Heat and Light Company, Ada, Ohio.

"Legislation, Its Uses and Abuses and Report of Advisory Committee," D. L. Gaskill, Greenville Electric Light and Power Company, Greenville, Ohio.

"Report of Committee on Uniform Accounting and Records," F. E. Crawford, Library Bureau, Cleveland, Ohio.

SECOND SESSION, 2.00 P. M.

Paper—"Electric Heating Devices, their Latest Commercial Developments," H. J. Mauger, Schenectady, N. Y.

Report of secretary and treasurer.

Election of officers.

Question Box.

Executive session.

Entertainment—Finishing of contests for prizes; bathing and games.

Officers, 1905-1906—W. E. Russell, acting president, Massillon, Ohio; D. L. Gaskill, secretary-treasurer, Greenville, Ohio.

Committees for twelfth annual convention—reception committee—B. S. Young, Ada, Ohio; W. J. Hanley, Columbus, Ohio; George Dusenberre, Cleveland, Ohio; A. A. Serva, Ft. Wayne, Ind.; L. B. Hoit, Cleveland, Ohio; George Porter, Columbus, Ohio; N. C. Cotabish, Cleveland, Ohio; Elliot Reynolds, Pittsburg, Pa.

Entertainment committee—F. W. Wilcox, Harrison, N. J.; A. C. Robeson, Greenville, Ohio; Fred Bissell, Toledo, Ohio.

Committee on arrangements—E. J. Bechtel, Toledo, Ohio; M. C. Hull, Columbus, Ohio; E. F. Gwynn, Delaware, Ohio; E. H. Beil, Youngstown, Ohio.

Electric Railway Statistics for Greater New York.

A pamphlet has been issued by the board of railroad commissioners of the state of New York in which are given statistics of the electric railway operation in Greater New York for the months April, May and June of this year, and, for comparison, the corresponding figures for the same months in 1905. The statistics cover the surface, elevated and subway lines.

The Manhattan division (elevated) of the Interborough Rapid Transit Company took in, during the quarter considered, 69,164,266 cash fares, an increase of 4,612,563 over the corresponding quarter of 1905.

The heaviest day was in April, when 938,959 cash fares were received.

The car-mileage for the recent quarter was 15,412,742, a decrease, as compared with the same months in 1905, of 460,871.

The total number of passengers carried on the subway for the quarter was 37,161,607, and the car-mileage was 8,656,535. The increases as compared with last year were 10,219,312 passengers and 961,413 car-miles.

The New York City Railway Company (surface) took in during the last quarter 101,971,383 cash fares, an increase of 2,911,928.

The car-mileage was 14,897,170, a decrease of 787,561.

The greatest number of passengers carried on one day was in May, it being 1,846,538.

The total number of cash fares for the borough of Manhattan for the quarter under consideration was 208,297,256, an increase of 17,743,800 as compared with the corresponding quarter of 1905.

The total car-mileage was 38,966,447, a decrease of 287,019.

For the borough of Brooklyn the following statistics are given:

The Brooklyn Heights Railroad Company took in 96,275,361 cash fares, an increase of 7,700,572 over the corresponding quarter of 1905. The car-mileage was 16,970,757, an increase of 965,913. The heaviest day was in June, when 2,129,264 passengers were carried.

The Coney Island & Brooklyn Railroad Company took in 9,462,173 cash fares and made a mileage of 1,813,041. There was an increase over the 1905 quarter of 517,083 fares and 25,876 miles.

The Van Brunt Street & Erie Basin Railroad Company collected 512,793 cash fares and made a mileage of 54,176. The increase in fares over 1905 was 47,009 and the decrease in mileage 567.

Figures in detail are given for the other three boroughs. The following is the general recapitulation for the whole city:

GENERAL RECAPITULATION.

ALL BOROUGHS.

Cash Fares.

	1905.	1906.
Boro. of Manhattan.	190,553,453	208,297,256
Boro. of Bronx.....	6,019,861	8,923,465
Boro. of Brooklyn..	97,985,663	106,250,327
Boro. of Queens.....	5,756,034	6,364,443
Boro. of Richmond..	2,144,676	2,549,359
Total	302,459,687	332,384,850
Increase		29,925,163

Transfers.

	1905.	1906.
Boro. of Manhattan.	41,150,524	46,844,211
Boro. of Bronx.....	4,147,299	4,356,415
Boro. of Brooklyn..	22,085,667	34,817,773
Boro. of Queens.....	1,023,280	1,212,174
Boro. of Richmond..	209,139	288,700
Total	68,615,909	87,519,273
Increase		18,903,364

Car-Mileage.

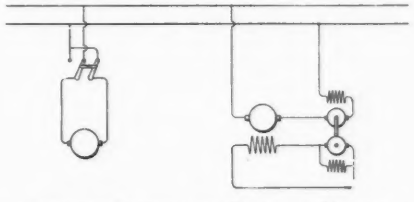
	1905.	1906.
Boro. of Manhattan.	39,253,466	38,966,447
Boro. of Bronx.....	1,656,516	2,025,433
Boro. of Brooklyn..	17,846,752	18,837,974
Boro. of Queens.....	1,168,947	1,256,711
Boro. of Richmond..	578,886	670,883
Total	60,504,567	61,757,448
Increase		1,252,881

A New South American Power Plant.

The city of Nichtheroy, some thirty miles north of Rio de Janeiro, Brazil, South America, has given its name to a new electric transmission system for supplying power and light to the towns of Cascatinha and Mage as well as the title city. Electricity is to be generated by water power and transmitted at 44,000 volts to substations at the cities mentioned. The installation is representative of the most modern engineering. At the main generating station the initial equipment will comprise three three-phase, revolving-field, 2,000-kilowatt generators, built by the General Electric Company. These machines, as well as two seventy-five-kilowatt exciter sets, will be driven by water-wheels made by J. M. Voith & Company, of Wurtemburg, Germany. The excitation current for the main governors will be furnished at 220 volts, the generator voltage being 2,300. This voltage will be stepped up to 44,000 volts in a bank of six water-cooled transformers, each having a capacity of 1,000 kilowatts and operating at sixty cycles. There is to be a spare 1,000-kilowatt transformer and a 3,000-kilowatt generator as a reserve. A very complete switchboard will be installed, all switches as well as rheostats being electrically operated from the board by remote control so that there will be no high-tension wiring at the switchboard. From the main generating station the power is to be delivered over a steel tower line to the three substations named in the foregoing. At the substations the transmission voltage is reduced to 6,600 volts for the local delivery. For this purpose there will be four 750-kilowatt transformers at Nichtheroy and four 350-kilowatt transformers at each of the other stations, Cascatinha and Mage. In each station one of the four transformers will be installed as a reserve. The complete electrical installation will be furnished by the General Electric Company through its representatives, Guinle & Company.

Distant Control of Electric Motors.

Horace F. Parshall, London, England, has obtained a patent (827,322, July 31) for an improved distant control electric motor, which he has assigned to the General Electric Company. The invention relates to systems of motor control of the type in which the motor is located at one point and its controlling mechanism at a point distant therefrom. Such systems are of particular application in the operation of electrically driven valves in ship-steering gear and the like. In systems of this type heretofore employed, in addition to the mains which supply the current to the motor other conductors are employed between the controlling point and the motor in order to control the direction of rotation of the motor. The principal object of the present invention



DISTANT CONTROL OF ELECTRIC MOTORS.

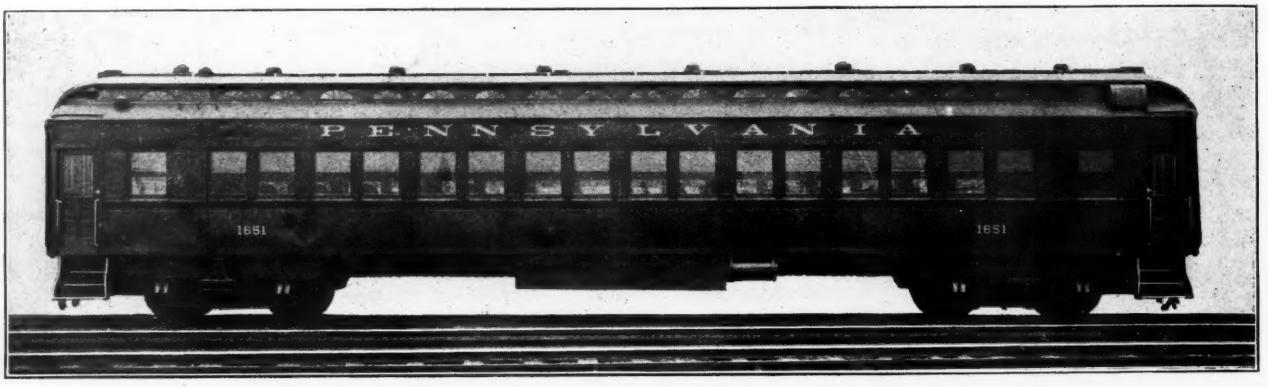
is to do away with these control wires and to provide means by which the direction of rotation of the motor may be reversed by simply reversing the direction of current in the supply mains. The invention consists in the combination of supply mains, a motor having one of its members connected to the mains and subjected to the same changes in direction of current as occur in the mains, and a motor-generator fed from said mains and operated to maintain the direction of current in the other member of the motor unchanged during changes in direction of current in the mains.

All-Steel Cars Adopted for the New York City Tunnel of the Pennsylvania Railroad.

The accompanying illustrations give an idea of the non-collapsible, fireproof passenger cars which have been adopted for the New York city tunnel of the Pennsylvania Railroad. This car, number 1651, has been placed temporarily on one of the company's regular local runs, and minute reports are being made as to its work.

The future passenger equipment is to be of steel, not only the frame and bodies, but of non-combustible material in every particular. The decision now definitely reached by the company will call for about 1,000 unburnable railroad cars to be ready when the New York tunnel is completed. It will also call for some 500 Pullman cars, which must also be of completely non-combustible construction. At the request of the Pennsylvania Railroad, the Pullman Company is now building the first all-steel sleeper ever constructed. It will be inspected by the Pennsylvania officials at an early date.

The new car weighs 103,550 pounds as against 84,900 pounds for the standard wooden coach. It is found that the added weight greatly reduces the vibration, adding to the comfort of the passengers. No inconsiderable part of the additional weight is due to the carrying of storage batteries and battery boxes. All the new cars are to be lighted by electricity, and the Pennsylvania company will carry no gas-illuminated cars of any kind into the New York tunnel. The electrical circuits of the new cars are all thoroughly insulated, and are placed in heavy metal conduits.



THE NEW FIREPROOF CAR FOR THE NEW YORK TUNNEL OF THE PENNSYLVANIA RAILROAD.

INTERIOR OF FIREPROOF CAR FOR THE NEW YORK TUNNEL OF THE PENNSYLVANIA RAILROAD.

It is stated that the new car is absolutely non-collapsible. The concealed frame work is built on the cantilever principle, suspended upon the trucks as piers. Safety against telescoping is secured by the use of heavy steel girders, the principal feature in the body of the car being a central box girder twenty-four inches wide by nineteen inches deep, extending throughout the length of the coach.

An attempt has been made to overcome the tendency, when trains are in collision, of the first car to sweep the superstructure of the second car off its underframe. In the new equipment, this is prevented by extraordinary strength in the door and vestibule end posts, which are of heavy rolled steel.

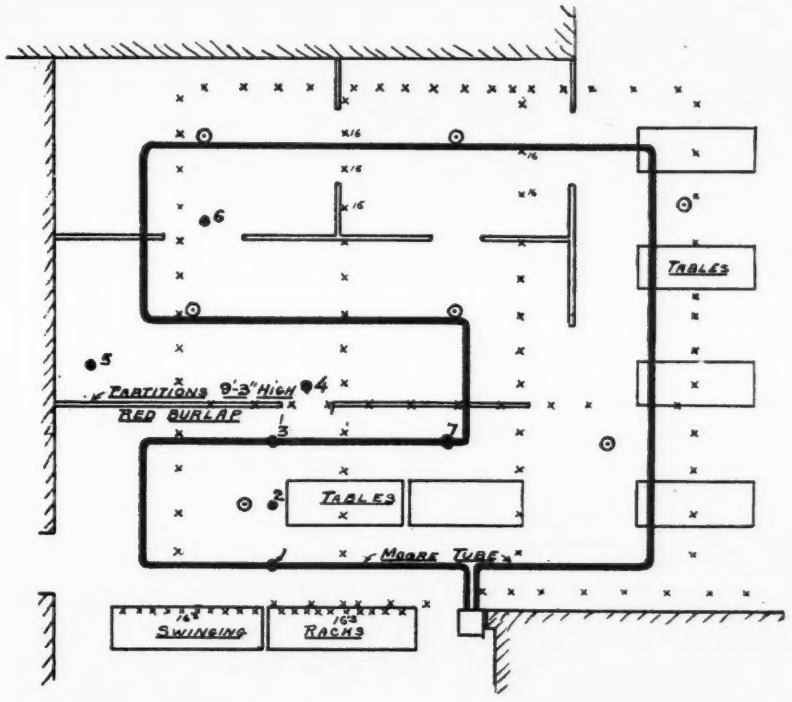
The flooring throughout the car and platform consists of an imitation of stone, spread, while in a plastic condition, over steel plates. The framing above the windows is composed of steel plates. The doors are composed of steel plates pressed into shape, imitating the wooden doors used in other cars and filled with cork to deaden the sound. The roof is constructed of composite boards covered with copper sheathing. The inside lining consists of composite boards covered with fireproof paint.

In the experimental car the seats are all of steel frame covered with fireproof plush. The foot-rests are also steel. For the present, the arm-rests are of wood, but experiments are now being made with various metals in the effort to secure a non-combustible material which will not be cold to the touch.

A coupler arrangement of a new type, said to be stronger than anything ever used before, has been designed for this car to avoid any possibility of breakage with the resultant parting of the train.

A Report on the Moore Tube Lamp.

The following report is interesting, in view of the attention with which the subject of illumination by artificial means is being watched. The report has been made by the Electrical Testing Laboratories, New York city, and the tests were made for the Illuminating Engineering Publishing Company under the general direction of E. Leavenworth Elliott. The lamps were installed in the picture department of the store of L. Bamberger & Company, Market street, Newark, N. J. The general arrangement of the space illuminated and the location of the illuminants is indicated in the accompanying diagram.



LAYOUT OF ILLUMINATING UNITS.

Measurements of illumination of the Nernst, incandescent and Moore lamps were made at seven points in a horizontal plane thirty-four inches above the floor. These test points were located in the space between the exhibition racks, whose illumination constituted the chief object of the installations. They are indicated on the diagram already referred to.

The ceiling of the illuminated space was metallic, finished in cream color. The walls and partitions were covered with red burlap, upon most of which pictures were mounted.

The Moore tube was 179 feet in length and one and three-fourths inches in diameter. The light emitted by the tube was characterized by a representative of the Moore Electrical Company as of an "orange tint." The tube had been in service about 1,000 hours, having been installed March 16, 1906.

The Nernst lamps were of the six-glower, alternating-current type, with opalescent globes of bluish tint. Within twenty-four hours before the test they were equipped with new 250-volt glowers. All glowers were burning.

The incandescent lamps were wired to molding on the ceiling, with the exception of twenty sixteen-candle-power lamps used with opaque reflectors for the illumination of certain swinging racks. These latter were of practically no utility in illuminating any of the stations investigated. The total equipment included eighty-eight eight-candle-power lamps and twenty-five sixteen-candle-power lamps. The bulbs of all the lamps were of clear glass and were cleaned immediately before the test.

The intensity of illumination was determined by means of a Weber photometer especially arranged for work of this character. This instrument, together with the instruments used in determining electrical conditions, was carefully verified in the laboratory of the Electrical Testing Laboratories at New York on the day of the test and on the following day.

All electrical values in connection with the Moore tube and the Nernst lamps were determined by instruments belonging to the Electrical Testing Laboratories, placed in circuit upon the service during the test. Because of differences in wiring arrangements for the incandescent lamps similar values could not be determined without great difficulty. Consequently, it was decided to remove nineteen of the lamps from their positions and by supplementary test, considering these lamps as representative of all those installed, determine with sufficient accuracy the total energy consumed by the incandescent lamps as installed. With this end in view the voltage conditions were carefully determined during the test, and supplementary tests at the Electrical Testing Laboratories upon the incandescent lamps were made at voltages as determined.

All the illuminants were used without reflecting devices of any kind.

RESULTS OF TEST.

Height of ceiling, ten feet eleven inches. Plane investigated, horizontal, thirty-four inches above floor.

	Moore.	Nernst.	Incandescent.
Height of illuminant above floor	9 ft. 6 in.	8 ft. 10 in.	10 ft. 8 in.
Number of units	1 tube, 179 ft. long, 1¾ in. diam.	7 6-glower lamps (250-volt glowers)	88 8-C.-P., 25 16-C.-P. lamps, clear bulbs
System	60-cycle	60-cycle	60-cycle
Average voltage of circuits during test	243	244	117
Kilowatts	3.15	3.92	4.13 (est.)
Volt-amperes	56.40	38.90	....
Indicated power-factor	56%	Unity	....

INTENSITY OF HORIZONTAL ILLUMINATION.

Test Station No.	Moore.	Nernst.	Incandescent.
1	68 luces	41 luces	21 luces
2	68 "	67 "	16 "
3	76 "	52 "	16 "
4	77 "	39 "	19 "
5	18 "	17 "	3 "
6	68 "	78 "	12 "
7	63 "	15 "	17 "
Average	63 luces	44 luces	15 luces
Average variation from mean index of degree of uniformity	20.3%	41.7%	28.1%
Average luces per unit energy	20.0%	11.2%	3.6%

NOTE 1—As all instrument parts, as well as the operator, were below the plane in which measurements of illumination were made, low intensities, such as those found at Station 5, can not be ascribed to objective interference.

NOTE 2—The unit of illumination used in this report is known as the lux, and is equivalent to the illumination produced on a plain surface by a source of one-candle-power at a distance of one meter, the rays of light falling upon the surface perpendicularly. One foot-candle is equal to 10.76 luces.

NOTE 3—All figures setting forth consumption of energy by the Moore tubes are measures of total energy consumed by

the Moore tube system, including all auxiliaries.

SUPPLEMENTARY TEST ON INCANDESCENT LAMPS.

Lamp No.	Rated Volts.	Operating Volts Tested at	Candle-Power.	Watts.	Watts per Candle.
1	No rating	117	7.2	31.5	4.37
2	" "	117	6.4	30.9	4.82
3	115	117	6.3	32 9	5.22
4	115	117	8.0	33.1	4.14
5	115	117	8.1	33.5	4 13
6	114	117	6.5	33.2	5.11
7	No rating	117	8.1	34 5	4 26
8	" "	117	7.0	31.9	4.56
9	115	117	7.7	33.1	4 30
10	No rating	117	6.4	31.3	4.90
11	115	117	7.7	33.2	4.31
12	No rating	117	4.3	27.3	6 24
13	115	117	9.6	36.4	3.79
14	117	117	7.4	32.1	4.33
15	No rating	117	6.2	29.1	4.70
	Average.....		7.1	32.3	4.62
1	118	117	12.2	52.4	4.29
2	115	117	15.0	50.6	3.38
3	115	117	13.7	55.6	4.06
4	110	117	13.5	49.2	3 65
5	115	117	15.5	50 8	3 22
	Average.....		14.0	51.7	3.73

ELECTRICAL TESTING LABORATORIES.
PRESTON S. MILLAR.

Checked by E. FITZGERALD,
July 18, 1906.

BLOW TO BAGGAGE MEN.

TRAVELING MEN DO NOT CARRY AS MUCH BAGGAGE AS FORMERLY.

Has the newly inaugurated interurban system and the increased trains on the steam roads brought the existence of the transfer men to a close and diminished the number of commercial men to about one-half, especially in this part of the state? asks the Springfield (Ill.) *News*. This question was discussed in the passenger office of one of the railroads by a man from a transfer company and the railroad agent. The question came up after a remark by the agent of the road that he never sees the trucks of the baggage man laden with the number of trunks which he was in the habit of seeing some few years ago when many times the trucks would hardly be able to hold the trunks of one commercial man, so great was the amount of samples that he then carried. This brought out the statement that the baggage of the commercial men passing through Central Illinois had decreased twenty-five per cent of the original size, and where two men were on the road for the same house in this immediate vicinity one has been taken off. This condition has brought about less business in the way of passengers for the transfer company, and the man from that company gave his reasons for the outcome. He laid it all at the door of the new interurban railways scattered thickly in this district and spoke of the decrease in his business here in Springfield. The transfer man stated that it is noticeable to him that men whom he sees coming in on the early morning train he will find leaving in the afternoon on trains which have been added to the service of the railroads because of the universal demand for additional and better service. Sometimes this same traveling man, while he may have several trunks, he has discovered that he is able to get out again early in the afternoon if he can get through, so he will not burden himself with having his trunks taken to the hotel, but will have one taken down and the balance left at the depot, so in case he has no use for them he will be able to catch the first train out without any difficulty. He is aware that he can get them on a minute's notice, but he realizes to take them all to the hotel and have them opened and the contents properly arranged about the sample room would take up the greater part of the morning, and should he find there was "nothing doing" he would be unable to catch the first train in the afternoon.

"When a traveling man has discovered that he is through with a town, there is but one other thing troubling his mind," said the transfer man, "'How can I get to the next place and how quick?'" Right here is where the reduction in the force of men covering the territory comes in. One man was formerly unable to go over the ground the company had given to two men and this was due to the poor service of the steam roads and the lack of interurbans. Now this same territory may be covered by one man in less time than two formerly covered it, and instead of two men and two sets of trunks to handle the transfer man has but one. Here again the interurban plays an important part in the passing away of the profitable transfer business. The interurban, which, it must be admitted, secure their share of the patronage of the commercial men who make the local stops and who formed the bulk of the transfer companies' business, now carry their passengers into the business districts of the city, and in most cases drop them within a few doors of the hotel. Here there is no cab fare, and in some cities, although not here, the hotels have their patrons use their own truck and go to the interurban depot and secure the guest's baggage. By this method the transfer man has no chance at the change of the traveling man, but the poorly paid hotel employé is given the benefit. So with half the men covering the territory as formerly, and with the disappearance of the cab service, occasioned by the electric lines running close to the hotels, and the baggage and commercial men reduced to just one-half, the transfer man is beginning to feel inroads on his business. The question rises, how are the hotels and railroads affected by the reduction of the force. While the hotels may somewhat suffer, yet the railroads are hardly affected, as the same amount of territory to be covered is just the same and just as often, and it is immaterial if one man pays two fares to the company or two men pay one fare each; it is equivalent in the end. The steam roads, of course, see a falling off of their local business occasioned by the inauguration of the interurban service, but then it seems to have aroused the desire on the part of the people to move and a greater traffic to more distant points has been created. The hotel men are not badly hurt by this new condition. While they may not have the commercial men in their hotels as long as formerly, yet by the great amount of men who run to this city after supper on the interurbans, rather than stay in the country over night, they are given a new business which amounts to more than the loss occasioned by the reduction of men covering the territory, and a man may now be the guest of one of the hotels every night during the week, yet in the day be working hard in one of the small towns a few miles from here. This was formerly impossible, owing to the poor service at these small stations, and when a man was seen to leave the hotel with his grip it was generally for good, but today it is generally for only a few hours. Then, too, the hotels are benefited by the increased patronage of their dining rooms and cafés. People who come to town must eat, and when there is no particular hurry about getting back to their homes they will prefer a hotel where they may spend a comfortable hour and then return on the late train or cars. As a matter of fact, there appears to be but one man and one business which has been seriously injured by the inauguration of the new system, and that is the transfer man in the city who has depended on the business between the hotels and the depots for his subsistence.—*Interurban Railway Journal.*

Aluminum.

Of its yearly production, estimated at above 10,000,000 pounds, the Pittsburg Reduction Company apparently exports but little of its aluminum. For June there was shipped from the United States aluminum valued at $40,364, bringing the year's total up to $318,531. Estimating the average price of the metal at thirty-three cents a pound, we have exports of only 9,652 pounds.

EFFICIENCY OF STEAM PLANT.[1]

BY WALTER A. VIGNOLES.

PRELIMINARY.

A year or two ago, the author's attention was called to the amount of coal used in electricity works per unit generated, and to the statement made in certain quarters that, to do an equivalent amount of work, engineers on board ship used considerably less coal than electrical engineers in their central stations; this led to the investigation of the quantity of coal and water used in the electricity works at Grimsby, of which the author is the electrical engineer, in order to test the accuracy of this statement.

Last year the author wrote a paper, which was published in the *Electrician* (London), in which the coal consumption in electricity works was compared with the published results of the steam trials of warships. In this paper a table was given (table 1), comparing the result of the trials of a battleship and of a cruiser, with a test run at the Grimsby electricity works. For purposes of comparison the marine engines were considered as driving dynamos, the overall efficiency being taken at eighty-five per cent, and the coal per kilowatt-hour was worked out on that basis. The two ships taken were the best and worst in the steam trials made during 1904. It will be seen that the evaporation at Grimsby was in all probability as good as in the case of H.M.S. Diamond, as the latter was no doubt using Welsh coal, while the coal used at Grimsby is fine slack; but both the ships used considerably less steam per kilowatt-hour than the electricity works. The author has endeavored to analyze in the following paper the coal and steam consumption with a view to showing where the losses are incurred, and how they can best be avoided or reduced. Conditions in an electricity works are entirely different to those on shipboard, and it is doubtful if any electricity works can compete in steam consumption with the best results obtained in ships. In this connection the author thinks that one of the great disadvantages on board ship, want of space, is a blessing in disguise. Space is so valuable that the boilers are placed close to the engines, the length of steam pipes is reduced to a minimum, and everything possible is done to avoid complications which would take up room; in this way a great many losses are avoided.

In considering the coal consumption of an electricity works, it is convenient to divide the subject into two parts:

A. Boiler house economy, or the generation of steam in an economical manner; where the problem is to deliver into the steam range as many pounds of dry steam per pound of coal as possible, and,

B. Plant economy; where the problem is to generate the energy with the minimum weight of steam delivered into the steam range, this including the steam used for auxiliaries; or, if the station has electrically driven auxiliaries, the units generated being considered to be the total units generated less the units used on the station for auxiliary purposes.

TABLE 1.

COMPARISON OF COAL AND STEAM CONSUMPTION—WARSHIPS AND ELECTRICITY WORKS.

Name of Ship or Works.	I. H. P. or K. W. Full Power.	I. H. P. or K. W. of Test.	Coal per I. H. P.-Hour.	Water per I. H. P.-Hour.	Water per Pound of Coal.	Assumed Overall Efficiency.	Equivalent Coal per K. W.-Hour.	Equivalent Water per K. W.-Hour.
Battleship Commonwealth	18,562 I. H. P	12,797	1.67	16.77	10.0	85%	2.66	26.6
Third-class cruiser Diamond	10,666 I. H. P.	10,066	2.98	21.6	7.25	85%	4.7	34.1
Grimsby electricity works, test peak, February 10, 1904	900 K. W.	211	....	.....[1]	6.57	....	7.1	46.6[1]

[1] Excluding stand-by coal.

A. BOILER HOUSE ECONOMY.

In the first place, to produce steam economically, the fuel must be burnt in an efficient manner, and the total heat units in the coal developed. To ensure this the fuel must be burned on a properly constructed grate, or by automatic stokers of a suitable pattern. Sufficient air must be supplied to the fire to ensure all the carbon in the coal being properly burned,

TABLE 2.

SHOWING PERCENTAGE OF TOTAL COAL BURNT, USED FOR STAND-BY PURPOSES.

	Figures for Week Ending October 13, 1904.		Estimated for One Week.		Estimated for One Week.	
	Totals.	Per Cent.	Totals.	Per Cent.	Totals.	Per Cent.
Units generated per week	23,241	...	27,510	...	2,520	...
Average per twenty-four hours	3,320	...	3,930	...	360	...
Maximum load, kilowatts	440	...	640	...	150	...
Load-factor, per cent	31.5	...	25.6	...	10	...
Number of boilers in use	3	...	4	...	2	...
Total coal burnt in week, tons	79.75	100	92.0	100	13.75	100
Coal for banking fires on boilers required for peak	1.5	1.9	3.0	3.3	1.5	10.9
Coal for banking fires on boilers kept as spares and used on peak, say, once a week	2.6	3.2	2.6	2.8	1.0	7.2
Total coal used for stand-by purposes	4.1	5.1	5.6	6.1	2.5	18.1

and to prevent any CO being left in the products of combustion. As is well known, if sufficient air is not supplied, CO is formed, and there is a great loss of heat owing to the combustion being incomplete, the heat generated by the combination of CO and O to form CO^2 being a considerable proportion of the total. On the other hand, the amount of air supplied must not be too great, otherwise the temperature of the gases is reduced unnecessarily, and there is a considerable loss owing to heat being carried away by the excess of air. It is usually considered that twelve to fifteen per cent of CO^2 is about the maximum to be anticipated in the flue gases, and in order to get this percentage it is necessary that the boiler, if of the water-tube type, should be enclosed by a thoroughly airtight casing to avoid air being drawn through the brickwork and so diluting the gases. CO^2 recorders have been recommended on many occasions, but, personally, the author has no experience of them.

The best way to make the setting of the boiler airtight is to entirely enclose it in a sheet-iron casing, as it appears to be difficult to avoid air leaks with brickwork settings.

As regards mechanical stokers the author has found the underfeed type very satisfactory, and thinks they offer many advantages. In working this type of stoker the fire should, in a water-tube boiler, be eighteen to twenty-four inches thick, and it is then difficult for an excess of air to pass through the fire, unless it burns into large holes; with the forced

[1] Paper read at the recent convention of the Incorporated Municipal Electrical Association, London.

draught in use the damper of the boiler can be kept very nearly closed, the opening being just sufficient to carry away the gases. The pull of the chimney on the casing of the boiler is then very much reduced, and less air passes through any leaks that there may be. The principal advantage with this type of stoker is that no moving parts are required in or near the fire, with the result that, if properly designed, the stoker costs very little for repairs as compared with those patterns where moving bars are used.

Five boilers at Grimsby are fitted with underfeed stokers of two different makes: these have been in use for from two to three years and have cost $36.75 per boiler per annum for repairs. This works out at four cents per ton of coal burnt by the stokers, and includes substituting steel worms for those originally fitted. Interest and repayment on the capital cost works out at 10.4 cents per ton of coal burnt, but the boilers have not been fully loaded.

Tests made at the works show that the efficiency of the boilers is about the same in the daytime as during the heavy load, and this is what might be expected, as boilers are added as the load comes on, each working at a moderate load as in the daytime. A certain amount of coal is used for stand-by purposes, for banking fires, etc., and on the tests published in the paper previously referred to, the amount of this varied from two to five per cent.

Table 2 shows the stand-by coal during one actual week and two estimated weeks, with different load-factors, and shows how variations in the latter affect the amount of coal required for this purpose.

Table 3 shows the results obtained by Ruthven Murray on the plant at Willesden as stated by him in a letter to the *Electrician*, June 30, 1905, and is useful for comparison.

TABLE 3.

TESTS MADE BY RUTHVEN MURRAY AT WILLESDEN—PUBLISHED IN A LETTER TO THE "ELECTRICIAN," JUNE 30, 1905.

Time.	Coal Percentages.				Evaporation.				Lbs. Coal per B. T. U.		Weight of Water per B. T. U. (Lbs.)
	Firing to Total.	Banking to Total.	Bringing Up to Total.	Banking, etc., to Firing.	Lbs. Water per Lb. Fuel, Total.		Lbs. Water per Lb. Fuel, Firing.				
					Actual.	From and at 212°.	Actual.	From and at 212°.	Firing.	Banking.	
8 A. M. to 4 P. M.	100.0%	.....	.....	.....	8.96	9.61	8.96	9.61	3.24	....	29.03
4 P. M. to 12 M	92.6%	.....	6.4%	6.9%	8.81	9.3	9.41	9.91	3.17	.217	29.77
12 M. to 8 A. M	81.1%	9.45%	9.45%	23.5%	11.1	11.47	13.7	14.07	5.7	1.34	78.14
24 hours	94.2%	1.1%	4.7%	6.29%	9.14	9.65	9.7	10.22	3.34	.21	32.44

TABLE 4.

TWO 24-HOUR TESTS ON PLANT AT GRIMSBY ELECTRICITY WORKS.

		May 3, 1906.	May 5, 1906.
Date of test			
Duration of test		24 hours	24 hours
Plant running		20 "	20 "
UNITS.			
Total generated		3,057	3,328.2
Used by fan		70	71
" " per cent total generated		2.29%	2.15%
Useful units generated		2,987	3,257.2
COAL.			
Total burnt	Lbs.	29,120	29,624.0
" " for stand-by	"	426	448
Per unit generated	"	9.54	8 9
Per useful unit generated	"	9.75	9.1
Average air pressure in main duct	Ins. water	1.84	1.75
Average air pressure in ash pit while draught was in use	"	.72	.78
WATER.			
Total pumped to boilers	Lbs.	192,300	174,400
" used by stokers	"	4,810	4,360
" loss separator drains	"	5,750	4,199
" loss blow-down and gauge glasses	"	5,790	5,152
" from condenser	"	148,525	142,174
" balance unaccounted for	"	27,425	18,515
" water per pound of coal	"	6.6	5.89
" water per unit generated	"	62.9	52.4
Water from condenser per unit	"	48.6	42.7
PER HOUR.			
Units—Total per hour	Lbs.	152.8	166.4
Useful " "	"	149.3	162.9
Coal—Burnt per boiler per hour	"	832	871
" " stoker " "	"	416	436
Water—To boilers per hour	"	9,615	8,720
From condensers per hour	"	7,426	7,109
Used by stokers per hour	"	241	218
Loss, separator drains, per hour	"	287	210
Loss, blow-down and gauge glasses, per hour	"	290	258
Balance unaccounted for per hour	"	1,371	925
TEMPERATURES.			
Water—Into economizer	° Fahr.	88.2	74.0
Out of "	"	232.5	243.0
Gases—Into economizer	"	520.0	548.0
Out of "	"	248.5	250.0

B. PLANT ECONOMY.

In this part of the subject we have to consider the pounds of steam used per useful unit generated at the terminals of the dynamos. This must include all steam used for auxiliaries of all kinds, such as feed pumps, forced draught engines, condensing plant, etc.; it must also include the steam condensed in the range and separators, discharged from traps or drains, etc., and, if the station has electrically driven auxiliaries, the current supplied to these must, as noted above, be deducted from the total units generated, and the useful units generated alone considered.

The total steam used in the station can be divided into three parts:

A. The amount of steam supplied by the boilers when the plant is ready to generate current, but without actually giving a supply. This includes:

1. Leaks from blowdown pipes, scum cocks, separators on boilers, etc.

2. Leaky drains on steam pipes, condensation in the ranges, blown through separators, etc.

3. Steam required by condensing plant maintaining a vacuum in the exhaust pipe.

4. Steam required for feed pumps, and any other auxiliaries it is necessary to run if the station is working at light load.

5. Steam required for one engine at light load, or supplying the current required for auxiliaries as above.

B. The extra steam required for auxiliaries to deal with the load.

C. The extra steam required by the engines to deal with the load.

The author made numerous tests a year or two ago of the amount of water pumped into the boilers per hour at various loads

on the plant, some short tests of two hours' duration, others of twelve and twenty-four hours, and on plotting the water per hour against the average load it was found that the points lay fairly well on a straight line, this line starting at a point above zero indicating the minimum steam consumption. Fig. 1 shows this, and dotted

During the past year the steam consumption at these works has increased, and on making a series of tests at different loads, it has been found that the points of the curve now lie above the first curve (Fig. 2) pointing to some loss of steam at all loads. In order to find the cause of this increase, tests have been

error in these tests; the total water to the boilers being measured by a meter is not very reliable, and tests checking this give somewhat variable results, but the usual figure is two or three per cent slow; but occasionally a test has shown the meter to be fast. It seems difficult at first sight to see how the meter can read fast, but on

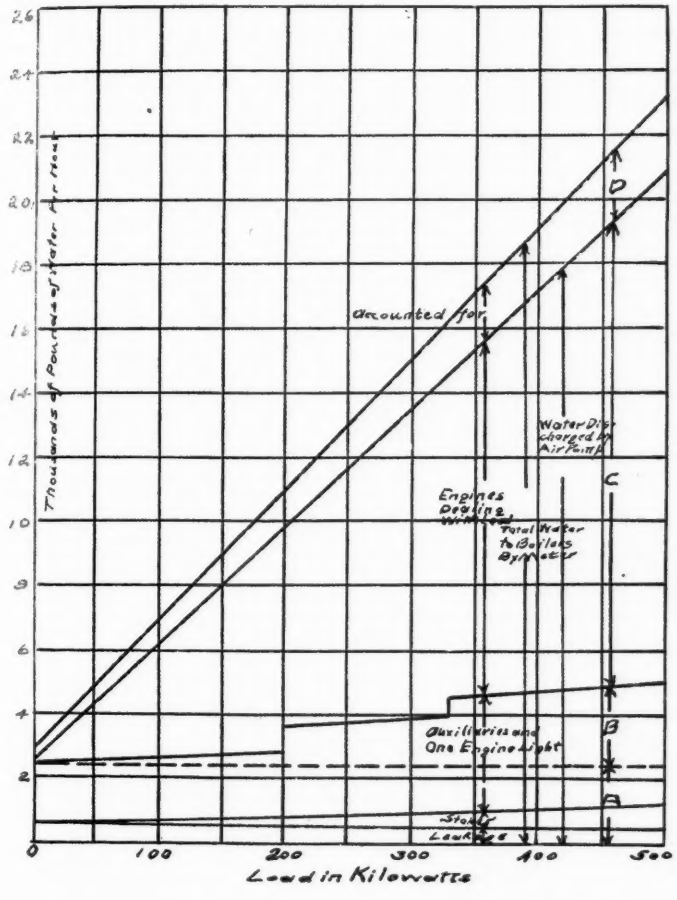


Fig. 1.—Curve Showing Steam Consumption Per Kilowatt at the Grimsby Electricity Works, 1904-1905.

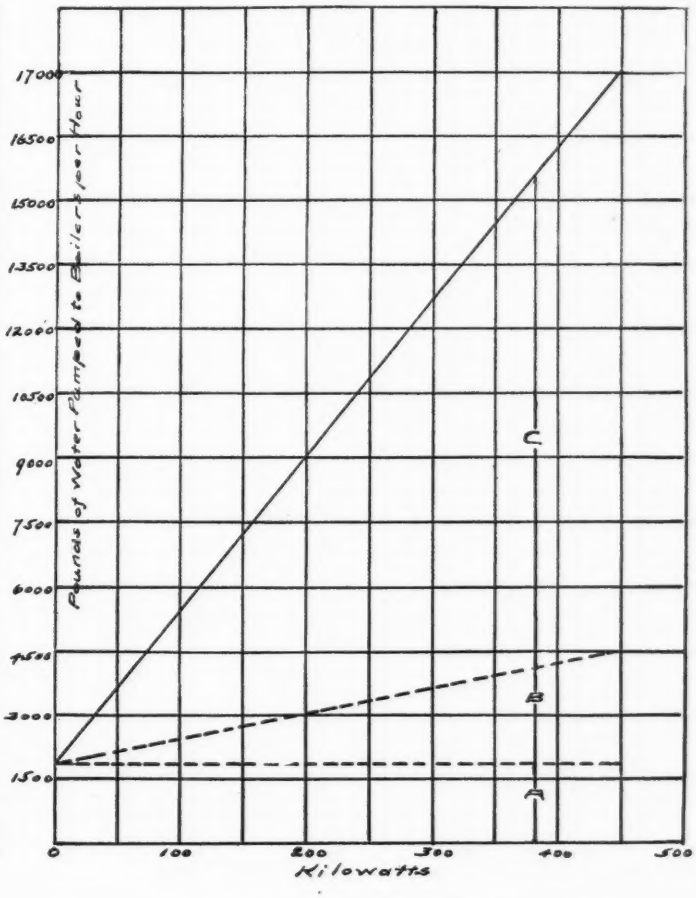


Fig. 2.—Curves Showing Analysis of Steam Consumption of Grimsby Electricity Works, 1906.

lines have been added to show how the total can be divided as set out above. If the steam used at no load be deducted from the total, the steam per kilowatt-hour works out at 33.7 pounds and the total water to boilers per kilowatt-hour is seventy pounds at fifty kilowatts, average load; about fifty-two pounds at 100 kilowatts and 37.5 pounds at 500 kilowatts. This curve is very useful, and is accurate as long as the plant is maintained in the same condition; if the average load on the plant is known for any period, say a day, or a week, or a month, the curve shows what the average steam consumption per hour should be. If such a curve be made for a station when the plant is new it forms a basis for comparison later on to show if the steam consumption is increasing from any cause.

made with a view of analyzing the steam consumption and measuring the losses.

Table 4 shows the results of two twenty-four-hour tests, in which the various losses of steam are shown, as far as can be measured with the apparatus available. The steam used by the stokers is calculated from previous tests, the results of which indicated a steam consumption of 2.5 per cent of the total water supplied to the boilers. The steam actually condensed in the range and blown through the separators was measured in a small condenser, as was the amount leaking from the blow-downs and gauge glasses. The amount of water returned by the air-pump discharge was also measured approximately by means of the tipping gear attached to the water-purifying plant. There are, of course, several sources of

one occasion it was undoubtedly due to air being drawn into the suction pipe by the feed pump, the water for the test being taken through a temporary suction pipe. The tipping gear is not very accurate, and there may be an error of five per cent in the amount of water measured through this.

Table 5 gives the average results of a number of tests of the water discharged from the condenser with the plant running light, ready to supply current, and also shows approximately how this total is made up.

The results of tests of the water discharged by the air pumps at various loads are shown by a line on Fig. 2, the starting-point being the amount of water discharged by the condenser at light load as given in table 5. The difference be-

tween this line and that showing the total water to the boilers is due to errors in measuring, to the make-up, *i.e.*, steam lost by leakage from the range, etc., and generally unaccounted for.

The steam consumption at the present time can therefore be analyzed as follows:

A. Stand-by losses, 2,450 pounds per hour, excluding 350 pounds per hour unaccounted for.

B. Extra steam required by auxiliaries to deal with the load, 5.1 pounds per kilowatt-hour.

C. Extra steam required by engines to deal with the load, 31.6 pounds per kilowatt-hour.

D. Unaccounted for, 350 pounds per hour plus 4.1 pounds per kilowatt-hour.

These figures show that the increase in the steam consumption is largely due to wasteful auxiliaries.

These curves may be compared with similar curves given by A. M. Taylor in his paper, read before the Birmingham section of the Institution of Electrical Engineers of Great Britain, on December 14, 1904, but which he worked out theoretically. Mr. Taylor proposed that his diagram should be built up by taking each item of plant and finding the steam required by, or the losses due to that plant, and building the various items up to form a combined diagram. In the present paper the process is reversed, the diagram having been made first and analyzed afterwards.

A few remarks on the lessons to be learned from a consideration of the above tests may not be out of place. First, the average load on the station is evidently very important, as the greater the load the smaller the stand-by losses are in proportion to the total. Where the maximum load on the station approaches the capacity of the plant, the load-factor is not very different to the average load divided by the capacity of the plant.

The load-factor has very little effect on the water evaporated per pound of coal, but a small load-factor increases the amount of coal required for banking fires during the day. The total steam consumption appears to follow the Willans law.

These tests bring out the enormous importance of the steam used for this purpose, and indicate the desirability of using electrically driven auxiliaries throughout.

There does not appear to be much difference between the economy of steam and electrically driven sets on the test plate. For example, a compound steam engine was installed at the Grimsby works a year or two ago, driving the air and circulating pumps; this took 808 pounds of steam per hour on test for the following duty:—pumping 68,000 gallons of water per hour against a head of twenty-six feet, and maintaining a vacuum of twenty-six inches of mercury while passing 7,000 pounds of water per hour through the condenser. A contract has recently been let for an electrically driven plant of the same capacity, but to pump against a head of thirty-five feet, and the makers have guaranteed a maximum consumption of twenty-seven units per hour under penalty. This at thirty-five pounds of steam per kilowatt-hour would represent about 940 pounds per hour. If, however, there is no saving shown on the test plate, the author thinks a very large saving would be shown in practice owing to the reduction in the length of the steam pipes and the number of valves, drains, etc.

In the author's opinion, almost any electrically driven feed pump would be more economical than a steam pump; but at the same time the mechanical question is very important and a searching investigation should be made into this point before adopting one. No doubt there are satisfactory electrically driven feed pumps on the market; personally, the author has had no experience with them, but this portion of the plant is one on which there should be no trouble in working, and great care should be exercised in its selection.

The curves show the advantage of using large units, as the steam required for the engines dealing with the load (C, Fig. 2)

TABLE 5.

LOSSES AT LIGHT LOAD—AVERAGE OF A NUMBER OF TESTS.

	Lbs. per Hour.	
Leaks, blow-down gauge glasses, etc	260	Included in water to boilers but not passing into condenser.
Condensed in range and blown through separators	340	
Engine driving pumps for condenser	800	Included in water from condenser.
One feed-pump	650	
One engine running light	400	
Total	2,450	

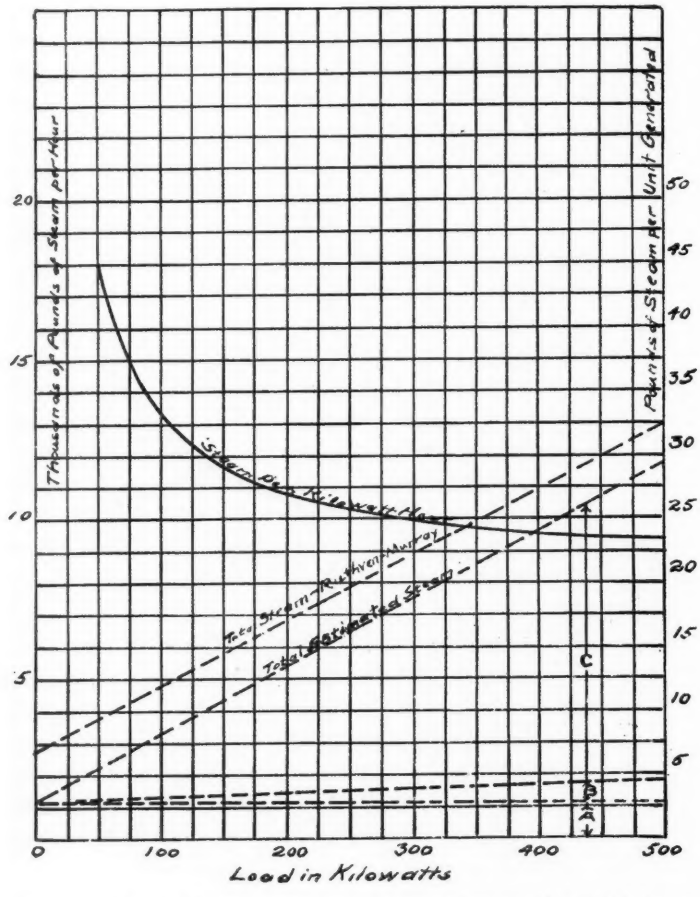


FIG. 3.—ESTIMATED STEAM CONSUMPTION OF A STATION RUNNING ONE 1,000-KILOWATT SET. CONDENSING, NO SUPERHEAT, 160 POUNDS STEAM PRESSURE.

would be largely reduced, while the only advantage of using a small set would be to reduce the starting-point of the curve slightly; as the steam used by the engine at light load is only a portion of the total, this is not very important, in fact, anything gained in this way would be lost by the waste in longer lengths of steam pipes, leaks at the extra valves, joints, etc., required by the larger number of sets.

As to the exact size of unit that should be adopted, if a plant is to deal with only one class of load, the author would suggest three 500-kilowatt sets, one as spare, in the case of a load with an estimated maximum demand of, say, 1,000 kilowatts. Each case must, however, be considered on its merits, and in very large stations the size of the unit is limited by the size it is practical to make. In cases where a traction load has to be supplied in addition to a lighting load, separate sets must be run to supply this, and sometimes, as at Grimsby, owing to peculiarities in the configuration of the town, the feeders have to be connected in the evening to two separate bus-bars at different voltages, and this increases the number of sets required.

The author's ideal station would be one with everything arranged to run from one large engine, with a second as a standby, boilers close to the engine, very short length of steam pipes, small number of bend, drains, etc., and with all auxiliaries electrically driven. Capital cost of spare plant must be considered in this connection, and if three or four sets were installed this would no doubt be reduced, but in any case it would be desirable to adopt at once the largest unit that could eventually be economically used.

Fig. 3 shows the estimated steam consumption in a station running one 1,000-kilowatt set, and equipped with electrically driven auxiliaries, the curve being calculated for saturated steam, 160-pound pressure. The losses at light load are as follows:

Condensation in the range	100	pounds	per	hour
Engine running light	700	"	"	"
Extra steam for generating current required by condensing plant	300	"	"	"
Ditto for feed-pump..	100	"	"	"

The steam for stokers is taken as 2.5 per cent of the total, and the steam for the engines to deal with the load at twenty pounds per kilowatt-hour.

It will be noticed that this curve shows a very large reduction in steam consumption for any load, as compared with the other curves; a second curve on the same figure is the one given by Ruthven Murray in his letter to the *Electrician*, June 30, 1905, as being the curve for the station under his control. In this case the double current generators used by Mr. Murray must be of great benefit in keeping the steam consumption down, as one large set can be used instead of two small ones.

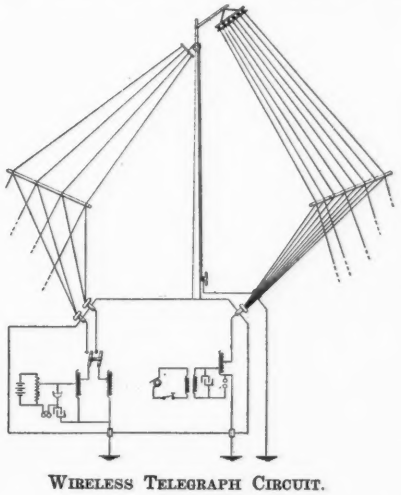
CONCLUSION.

In discussing this paper it must be remembered that all the tests were made on the plant under ordinary working conditions. The tests quoted are not given as being good examples of efficient working, as it is recognized that they show many points where economies should, and the author hopes will, be made, but the paper is put forward as an attempt to show what goes on in a central station with a plant five years old.

Great difficulties were experienced at times in getting one test to check with another, and at best the accuracy is not very great, but as much as possible has been done with the plant and staff available.

Electrical Patents.

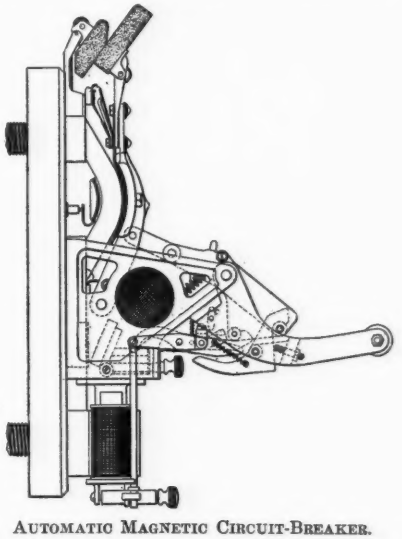
Lee De Forest, New York, N. Y., has obtained a patent (827,523, July 31) for an improved wireless telegraph system. The invention relates to wireless telegraphy and has for its object a system



WIRELESS TELEGRAPH CIRCUIT.

which is provided with separate transmitting and receiving antennæ at the same terminal station and which thereby has the advantage that the receiving operator at the station is enabled to cut in upon and interrupt the transmitting operator at another station. The invention consists in the combination with transmitting and receiving systems at a terminal station, of separate multiple antennæ for the transmitting and receiving systems, the transmitting multiple antenna comprising a larger number of conductors than the receiving multiple antenna and having its conductors more closely spaced than those of the receiving antenna, and means for attuning the transmitting and receiving antennæ to different frequencies.

An improved automatic magnetic circuit-breaker has been invented by William M. Scott, Philadelphia, Pa. (827,469, July 31). The invention relates to electrical switches for heavy currents and high voltages, especially to the automatic type adapted to control a cir-



AUTOMATIC MAGNETIC CIRCUIT-BREAKER.

cuit or circuits either by the rupture or closure of the circuit, or circuits upon the occurrence of predetermined electrical conditions, as, for example, either an abnormally great or small flow of current, abnormally high or low voltage or pressure, or upon a reversed flow of energy or of current. The invention resides in a structure and disposition of parts, whereby it shall be impossible for an operator during the existence or continuance of predetermined electrical conditions to actuate the switch member of the circuit-breaker to lock it or to hold it in a position from which undesired results might follow in virtue of such predetermined electrical conditions. The invention consists of a movable contact member, an actuator therefor, a latch for restraining the movable contact member in normal position, a latch for connecting the actuator, a movable contact member, an independent lever for actuating the latches, and electroresponsive means for actuating the lever whereby the movable contact member is released and disconnected from the actuator upon the occurrence of predetermined electrical conditions when the contact member is in normal position, and for disconnecting the contact member from the actuator upon attempted movement to normal position during the existence or continuance of predetermined electrical conditions.

Reviews of Current Engineering and Scientific Literature.

Operation of Railway Switches and Signals by Power.

A description is given here of the electrical locking system as it has recently been developed to meet British ideas. This system is an improvement of the one now employed at Bethnal Green on the Great Eastern Railway. The controlling handles resemble miniature switch handles rocking back and forth instead of from one side to the other. This motion of the handle closes the control circuit which sets in action the pneumatic cylinder, which throws the switch as moved to its final position. The locking is accomplished by means of two electromagnets. The controlling switch is closed by means of a bar, which is moved horizontally by the operating handle. When in one position, this closes one end of one of the locking circuits. The other end circuit is closed by the switch tongue when it has completed its movement. The motion of the horizontal bar is limited by two pawls which are released by the two magnets, thus when throwing a switch the controlling handle is moved half way when its motion is locked by one of the above pawls. This motion, however, closes the controlling circuit for the air cylinder which throws the circuit, and, after the switch has completed its motion the circuit is closed, which lifts the locking pawl and enables the handle to complete its motion.—*Abstracted from Engineering (London), July* 27.

Dangerous Switchboards and Transformer Stations.

In a report submitted recently, Scott Ram, the British electrical inspector of factories, criticizes certain practices which he has encountered. He particularly points out the dangers often existing at high-tension switchboards and in transformer stations where sufficient space for passageways and for operating the switches has not been left. With the increasing supply of electrical energy over large areas the use of extra high pressures is becoming more and more common. It would be thought that this would lead to the use of every precaution which could be taken against an accidental shock, yet, as an example, the inspector found at one station in the switchboard area a passageway four feet wide between two rows of vertical brick cells facing each other. On each side of the passageway the cells contained isolating switches working at 10,000 volts. The switches and other connections are all of bare metal, and when closed the live metal is about eight inches back from the front of the brickwork. There is no screen or other protection in front of the cells. On one side the switches are about five feet six inches from the floor, and on the other side about two feet. When the blades are in the off position they project eight inches into the passageway, and should they become alive they would be exceedingly dangerous to any employé whose work might take him through there. The safe width of the passageway is thus reduced to about two feet. Further, the operation of these switches provides additional danger since they are opened and closed by means of a pole, necessitating the attendant to stand as far back as possible toward the opposite side with his back near the live switches there. In another case the inspector found a narrow passage with extra-high-pressure bus-bars alongside without any attempt at protection. A number of other instances are mentioned in which there was little or no attempt to protect employés from coming in contact with high-potential apparatus. —*Abstracted from the Mechanical Engineer (London), July* 28.

Wireless Control of Submarine Boats.

A description is given here of the controlling apparatus employed during the tests at Antibes Bay, France, of a submarine boat whose actions were directed by means of wireless telegraphy, a reference to which was made in the Electrical Review for June 2. During these tests it was possible to start and direct a boat in any direction and to discharge a torpedo. The boat carried a storage battery which supplied power for all movements. To control the propeller motor and the rudder motor, to light and extinguish the signal lamps, and to discharge the torpedo, local circuits are provided on the boat. These can be closed by means of an arm rotating over a series of contact posts. There are twelve of these contacts. Three are not connected to any circuit. The other nine are employed for the operations mentioned. This arm is rotated to the desired point, thus bringing about the desired action. By means of a ratchet wheel it is moved forward progressively step by step by an electromagnet. This magnet is actuated through a coherer which responds to the electric waves sent out from the directing station and a relay. By means of it the arm can be brought to any contact, and thus close the circuit. To prevent action other than that desired taking place, as the arm passes from point to point, the main power circuit is automatically opened whenever the ratchet moves, the switch tending to close each time the ratchet returns to its position of rest, thus when the motion has been completed the power circuit is closed and the proper motor brought into action. To prevent this taking place during the setting of the distributing arm, a frictional device, which drives a small flywheel, retards the closing of the main switch, so that this action can not be completed until the magnet has ceased to operate. The battery carried on the boat has a possible discharge rate of 100 amperes and sufficient capacity for four hours' continuous operation.—*Translated and abstracted from the L'Electricien (Paris), July* 28.

A Method for the Determination of Iron Losses in Pole Shoes, Due to Armature Teeth.

A method of determining the losses due to eddy currents set up in the pole shoes of a dynamo by the armature teeth is here described by T. F. Wall and S. P. Smith. These losses occur to some extent even when the pole shoes are laminated, and their calculation and separation from the total losses are difficult. The method employed by the authors consists in determining the temperature produced by these losses in the pole shoe and then measuring the electrical energy required to maintain the pole shoe at the same temperature, all other conditions of operation remaining the same with the exception that in the latter case the pole under consideration is not magnetized. To accomplish this four slots were cut in the pole shoe on the side facing the pole, and two coils were placed in these slots. Thermoelectric junctions were constructed by soldering thin copper strips to various points on the pole shoe. To prevent the conduction of heat from the shoe, it was insulated by means of mica. The thermoelectric junctions enabled the tempera-

ture of the shoe, reached under normal operation, to be determined and made it possible to adjust the heating current passed through the two coils mentioned above to be adjusted so as to bring the pole shoe to the same temperature. To maintain other conditions constant a four-pole field was selected. The magnetizing coils of two poles were disconnected and the two coils of two opposite poles only were used. Passing the current through these coils so as to make one a north and the other a south pole prevented any part of the magnetic flux from passing across the other two air-gaps, while reversing the current in any one of the two coils caused all four poles to become magnetized. During the test the machine was run at constant speed, and each test lasted four hours. The machine used during the test was a small one, and it was found that the loss per pole shoe varied with the flux density from forty watts, with a density of 2,100 lines per square centimeter, to seventy watts with a density of 2,900 lines. The loss also varies with the speed, being twenty-two and one-half watts per shoe, at a speed of 600 revolutions per minute, and seventy watts with a speed of 1,300 revolutions per minute. The density during the latter test was 2,900 lines per square centimeter. In the former tests the speed was constant at 1,300 revolutions per minute.—*Abstracted from the Electrician (London), July 27.*

Interference in Wireless Telegraphy and the International Telegraph Congress.

In concluding the series of articles on "Interference in Wireless Telegraphy," Professor R. A. Fessenden explains a number of tests which he has made to determine to what extent interference may take place between different systems and how this may be prevented. He was able to receive at Brant Rock, thirty miles from Boston, Mass., messages sent from Machrihanish, Scotland, although another station at Boston was trying to prevent this. The latter station succeeded in getting within three per cent in tune with the receiving station, and had at its disposal about fifteen kilowatts, but it could not render the signals unintelligible. The author does not think that the methods of directing wireless telegraphy which have been published, with the exception of Marconi's, are of any value. He has done some work in this direction by means of a horizontal iron transmitter screened on one side, but a more promising method consists in utilizing a transmitter submerged in distilled water. Water has eighty times the specific inductive capacity of air, and hence with the same apparatus, the length of wave is nine times as great and the energy eighty times as great as when used in air. He suggests a copper cylinder placed in a wooden vessel which is filled with water and covered with oil to prevent evaporation. A metallic reflector made of suitable shape may be placed at one side. With a cylinder one foot high, which would correspond to a cylinder of the same diameter eighty feet high in air and with a reflector 100 feet in diameter, a strong focusing of the waves should be obtained. The article concludes with a suggested method of international working. Professor Fessenden is opposed to government operation whenever it is not absolutely necessary, but he believes that some understanding should be reached and action taken to insure the safety of ocean traffic. This can best be done by the international adoption of two different wave lengths, one for mercantile use and the other for navy and army use. These might be for example 500 amperes and 550 amperes. Private systems should be allowed to operate at any wave lengths they may desire, except within five per cent on either side of the two mentioned above. A separate wave length should not be used for distress signals, for then it would not be likely to attract attention. A proper distress signal would be the repetition of a single letter, which would sooner or later attract attention. The limits set above allow for about forty different tunes, which the author believes to be sufficient for practical purposes.—*Abstracted from the Electrical Review (London), July 27.*

Recent Tests of Turbo-Alternators.

A description is given here by M. L. LeGros of some recent turbo-alternators constructed by the Oerlikon Company, and of the tests to which they were submitted. These machines are of the usual type with a revolving field and a stationary armature. They varied in output from 550 to 2,200 kilowatts. The wave form of the machines was determined both by point readings and by an oscillograph. The results agreed closely and showed a somewhat wavy form due to the teeth of the stator. The regulation characteristic was determined experimentally and computed from the usual tests, the results agreeing well. To determine the efficiency of the generator, the losses were measured in several ways and the efficiency computed from these. This was necessary, as it was not convenient to put a load upon the machine. To determine these losses, the retardation method was employed, the machine being brought up to full speed, then disconnected and allowed to run until it came to a stop. Measuring the negative acceleration and knowing the moment of inertia of the rotor, it was possible to compute the friction and windage losses, and repeating the experiment with the fields excited enabled the iron losses to be determined. To check these results and also to act as a check upon the computed moment of inertia, the tests were repeated, using the exciter to supply power at different rates during the test. Measuring the power thus supplied and the rate of retardation made it possible to deduce in this way the moment of inertia and to obtain fresh determinations of the losses. The agreement upon the results obtained from these ways was fairly good, the computed moment of inertia being within two per cent of that determined from the test. A heating test was made by running the generator on short-circuit with the field excited so that internal losses were somewhat greater than those which would occur when operating normally under full load. The efficiency of one machine, rated at 2,400 kilovolt-amperes, was about ninety-five per cent at full load and unity power-factor. It dropped to 93.3 with a power-factor of 0.8. At half load, the respective efficiencies were 91.4 and 87.8. The heating test showed that the temperature rise under the abnormal conditions employed was about forty-five degrees centigrade.—*Translated and abstracted from L'Eclairage Electrique (Paris), July 28.*

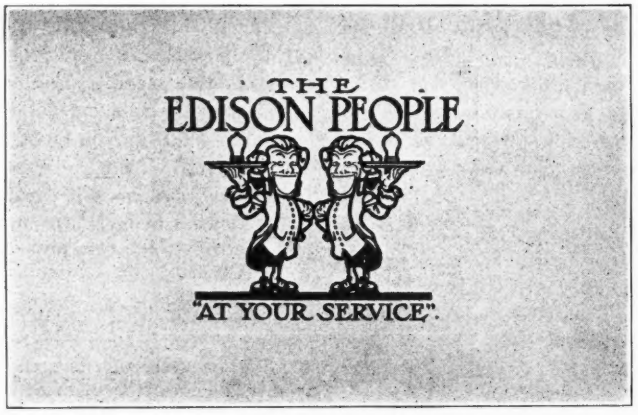
The Valle Maggia Single-Phase Railway.

The railway which is now being equipped between Locarno and Bignasco is the second line in Switzerland to be equipped on the single-phase system, the first having been that between Seebach and Wettingen, says the *Electrician* (London). The line is about seventeen miles in length and is of metre gauge, the maximum gradient being 3.3 per cent. The pressure adopted on the overhead line is 5,000 volts, which is, with the exception of the 15,000-volt Seebach-Wettingen experimental line, the highest trolley pressure yet authorized by the Swiss Federal Railway authorities. The motor-cars have four axles, each of which is driven by a forty-brake-horse-power Oerlikon single-phase motor, and trailers are employed both for passengers and goods, the complete trains weighing about fifty-five tons. The Oerlikon curved bar collector is used. Power is obtained from a water-power station about ten miles from the line, where two alternators are installed, each for an output of 350 kilovolt-amperes, and driven by turbines working with a fall of about eighty feet.

Methods of Getting New Business.

A department devoted to the commercial development of Central Stations. Managers are invited to contribute suggestions for methods of increasing the demand for electric service.

The New York Edison Company, in line with its policy of distributing to its customers and to prospective consumers of current samples of high-class advertising literature, has prepared and is now distributing one of the most unique advertising booklets which has come to our notice. The Edison Company has created a series of characters showing numerous applications of electricity for comfort, safety and convenience. The attitude and expression of satisfaction depicted by these characters speak a content with Edison service which its many subscribers appreciate. The cover of the Edison book is in drab, the illumination being printed in dark brown. The inside pages are of cream stock, the text and illustrations being in brown, black and orange. There are some fifty odd applications illustrated. In addition to the illustrations, however, there is some well-chosen literature, calling attention to the utility of this service. During 1905, 19,680 contracts for electrical service were made. This was divided up as follows: 992,782 incandescent lamps, 6,719 arc lamps and 37,719 horsepower in motors.

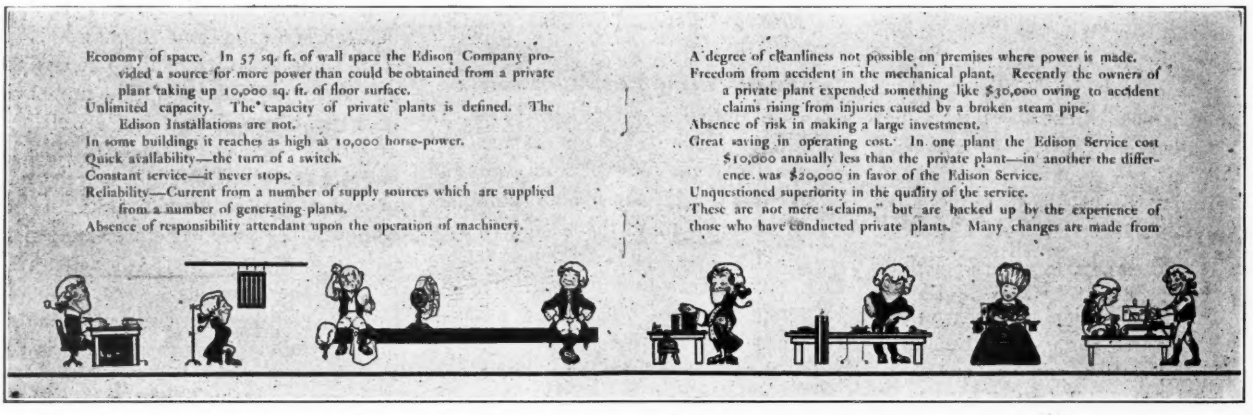


THE COVER PAGE OF THE NEW YORK EDISON BOOK.

The accompanying illustrations show respectively the cover and the inside double-page. The book measures six inches by nine and one-quarter inches, and the type is large enough to be easily read. Every phase of industry is touched upon, as well as the opportunities for electric service in the household. The electric sign is suggested as an instance of the immediate hold which electricity has taken upon business men as an advertising medium of unquestioned value.

The Phelps Company, Detroit, Mich., has begun the widespread advertising of "Hylo" lamps by means of illuminated posters bearing the signature of the lighting company in numerous towns. The accompanying illustration shows a poster which is now in use at Fort Wayne, Ind. This poster is of the regulation four-sheet size, is printed in colors, and calls attention to the fact that the Fort Wayne & Wabash Valley Traction Company will deliver "Hylo" lamps on thirty days' free trial. This is an example of where the manufacturer, operating together with the lighting company, can do much to facilitate and promote the use of current.

A FORT WAYNE "HYLO" POSTER.


Economy of space. In 57 sq. ft. of wall space the Edison Company provided a source for more power than could be obtained from a private plant taking up 10,000 sq. ft. of floor surface.
Unlimited capacity. The capacity of private plants is defined. The Edison Installations are not.
In some buildings it reaches as high as 10,000 horse-power.
Quick availability—the turn of a switch.
Constant service—it never stops.
Reliability—Current from a number of supply sources which are supplied from a number of generating plants.
Absence of responsibility attendant upon the operation of machinery.
A degree of cleanliness not possible on premises where power is made.
Freedom from accident in the mechanical plant. Recently the owners of a private plant expended something like $30,000 owing to accident claims rising from injuries caused by a broken steam pipe.
Absence of risk in making a large investment.
Great saving in operating cost. In one plant the Edison Service cost $10,000 annually less than the private plant—in another the difference was $20,000 in favor of the Edison Service.
Unquestioned superiority in the quality of the service.
These are not mere "claims," but are backed up by the experience of those who have conducted private plants. Many changes are made from

A SAMPLE OF THE INSIDE PAGES OF THE NEW YORK EDISON BOOK.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

The Victor Combination Meter.

The H. W. Johns-Manville Company, 100 William street, New York city, has placed on the market a combination meter designated as the "Victor," giving a simultaneous reading of volts, amperes, watts and horse-power on one dial. This is practically two separate and complete in-

FIG. 1.

struments combined in one case, each of which acts independently of the other as far as the volt and ampere readings are concerned. The readings in watts and horse-power are obtained from the point of intersection of the two indicators.

The company states that this instrument as a wattmeter is accurate at any voltage within the limits of the voltage

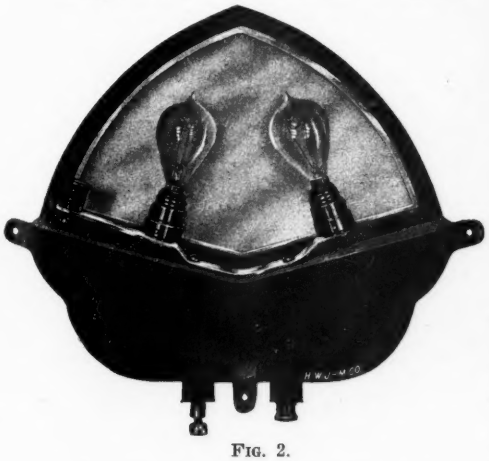


FIG. 2.

scale. The wattage scale is laid out from actual calibrations with a reliable standard, insuring accuracy in the result. The horse-power scale is obtained mathematically from the wattage scale. The company states that the workmanship and materials employed in the manufacture of this instrument are of the highest order, insuring accuracy and durability. While light in weight, it is rigid and will withstand vibrations of considerable violence without its accuracy being impaired. It requires a minimum of energy to operate, is sensitive and free from magnetic lag, unaffected by temperature variations, dead beat, and can safely remain continuously in circuit.

The instruments are illuminated from the rear, saving space on the smallest panels. Fig. 1 and Fig. 2 show, respectively, the front and rear views of this instrument.

The San Francisco Office of the Shelby Electric Company.

The accompanying illustration shows the San Francisco (Cal.) office of the Shelby Electric Company, of Shelby, Ohio, located at 320 Sansome street. The company claims the honor of being the first incandescent lamp company to open an office in San Francisco after the earthquake. The gentleman standing in the doorway is O. D. Pierce, the company's western manager.

THE SAN FRANCISCO OFFICE OF THE SHELBY ELECTRIC COMPANY, SHELBY, OHIO.

Electric Railway Building in Oregon.

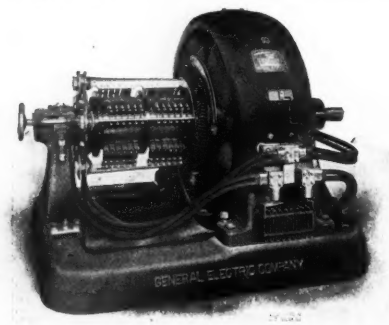
The Oregon Electric Railway Company is entering the Willamette Valley, south of Portland, with an electric road constructed for the handling of freight as well as passengers. This road opens up a rich territory in the centre of which is located Salem, the capital of Oregon. The first section of the railroad will be fifty miles in length and will connect the city of Portland with Salem. It will be constructed, in accordance with the best railway practice, of seventy-pound rails on rock-ballasted roadbed, with a maximum grade of 2.2 per cent and a maximum curvature of five degrees. A portion of the fifty-mile line will consist of a tangent of twenty-six miles with practically no grade. The road crosses the Willamette river, over which is being constructed a steel-deck span bridge on concrete piers. There are five piers in the river, and the approaches to the bridges on either side consist of fills aggregating some thousand feet in length. The bridge proper consists of four 200-foot spans, the distance from the rail to the surface of the river being 110 feet. This is one of the largest bridges in the state and is being constructed for the heaviest type of electric locomotive drawing trains of 100,000-pound freight cars. The road enters the southern boundary of the city of Portland and continues into the centre of the city, where the passenger station is located. Connection will here be made by the Southern Pacific, Northern Pacific

and Great Northern railroads. There will be a number of branches, aggregating some fifty miles, constructed as soon as the main line is in operation, and plans are in contemplation to extend the main line to the south of Salem to the city of Eugene, making an electric railway system of some 150 miles.

All of the engineering and construction work is being done by W. S. Barstow & Company, Portland, Ore. Among the financial people interested in the enterprise are Moffat & White, bankers, New York; Charles Pratt & Company, New York; Franklin Trust Company, Brooklyn, N. Y., and numerous other financiers of the East and West.

High-Speed, High-Overload-Capacity Motors for Testing Purposes.

Several especially interesting motors have recently been installed for testing purposes by the International Steam Pump Company in its new Worthington hydraulic works at Harrison, N. J. The motors were built by the General Electric Company, Schenectady, N. Y., and are used in testing blowers, pumps, air-compressors, etc., being permanently installed on suitable foundations in such a way that the machinery to be tested can be easily brought up to them. The machines are



High-Speed, High-Overload-Capacity Motors for Testing Purposes.

remarkable because of their high overload capacity and wide speed range for these purposes.

The largest of these units is shown in the accompanying illustration. This motor delivers 200 horse-power at 220 volts running at 750 to 1,500 revolutions per minute, and 100 horse-power at 110 volts running at 375 to 750 revolutions per minute. A similar range in capacity and speed is obtainable with each of the other motors, having full-load rating of 100 horse-power, thirty horse-power and ten horse-power respectively, at 220 volts.

All the machines are of the four-pole type and will carry fifty per cent overload for two hours at any speed within the range specified. The motors operate on the three-wire system, the fields being excited from the 220-volt mains, and the armatures being connected through double-throw switches to the 220-volt or 110-volt mains, according to the speed range required. The speed ranges are obtained by field control, and the 200-horse-power and 100-horse-power machines are built with commutating poles. A German silver resistance, shown just below the terminal board in the illustration, is used to make the final adjustment of the current in the commutating field coils. By this arrangement sparkless commutation at all loads, including fifty per cent overload, is obtained.

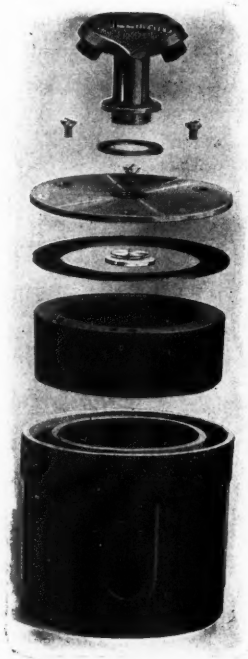
Aside from the large capacity and high speed range, these motors have several interesting structural features. On account of the high surface speed of the commutators in the 200-horse-power and 100-horse-power machines, an improved shrunk ring type of commutator is used. The brush rigging is similar to the form recently adopted in high-speed direct-current Curtis turbine-generators. The brush-holder studs are of stiff, ribbed design, and the brush holders are secured to the studs by bolts passing through machined joints of special form, making the entire brush system extremely rigid in spite of the unusual length of the studs. The motors are materially lightened by making the magnet frames of steel, and both armature and field coils are built to give proper ventilation at the overload capacity. Particular attention has been paid to balancing rotating parts so that vibration within the wide variation of speed and load is eliminated.

There is a wide field among machinery manufacturers for motors of this type having high overload capacity with high speed range, not only for permanent installation for general testing work, as in the case of the machines for the Worthington works, but also for the driving of machine tools.

Water-tight Floor Outlets.

The accompanying illustration shows the assembly of the "Fullman" water-tight floor outlet, manufactured by the Steel City Electric Company, Third street and Penn avenue, Pittsburg, Pa. Beginning at the bottom of the illustration, the parts appear as follows: box body, adjusting ring (made in various heights), gasket and brass plug, brass plate and attaching screws, nozzle gasket and brass drip nozzle. The illustration shows the standard plain outlet. These outlets are also furnished with suitable arrangements for receiving standard plugs and receptacles.

This outlet has been used in a great many special forms, such as with larger boxes with partitions for supplying several kinds of service at one outlet. The



Water-tight Floor Outlet.

universal adjustment feature may also be supplied with a flange to attach to special forms of large boxes, either round, square or rectangular.

The box body, when set with "roughing-in" work, is subject to much interference by workmen carrying on other details of construction, which causes it to be more or less out of exact level when the finished floor is laid. This is taken care of by the adjusting ring dipping into the groove more on one side than on the other. Adjustment for elevation is made by raising or lowering the ring in the groove. When the ring is properly set the groove is filled with melted compound, sealing the box and securing the parts in place. Templets for setting the rings are furnished. These templets fasten to the ring and rest on the floor, making the adjustment instantly without trial.

A New Gasolene Torch.

The Zeidler Lamp and Brass Company, Lomira, Wis., for which the Boggs-Howland Company, 23 Warren Street, New York city, has the eastern selling agency, has placed on the market the "Baby" gasolene torch, an illustration of which is shown herewith. The novelty of this device is its small size, absence of air pump,

cocks or valves, and its inherent simplicity. The nickeled brass fount is two and one-half by one and seven-eighths inches, the curved tube one-quarter inch in diameter, and the friction-tight Bunsen tube, with

"Baby" Blow-Torch.

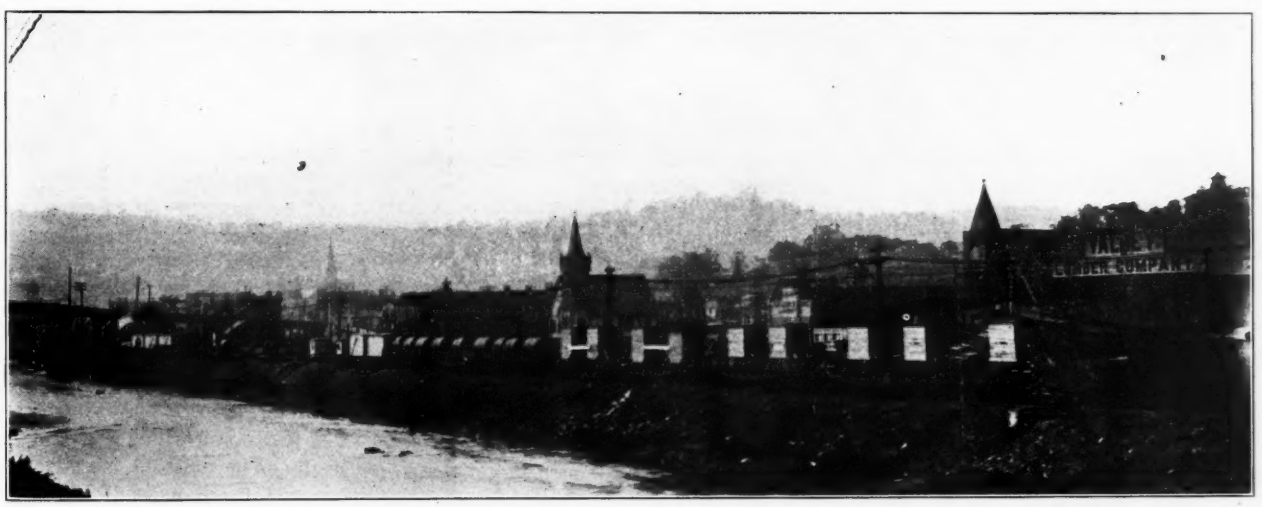
eight three-thirty-seconds-inch holes, is two and one-half by seven and one-sixteenth inches in dimensions. Inside, a loose cotton wick, attached for convenience to a small strip of brass, serves as the conductor of the fluid, not coming in contact with the flame. Two or three lighted matches held under the curved tube heat and vaporize the volatile material, producing a jet of fire. The device is recommended by the company as peculiarly suitable for telephone and telegraph linemen and other electricians. In size the device fits the hand, and in use can be turned in any position, burning equally well in all.

A Large Shipment from the Westinghouse Company.

One of the largest single shipments recently made from the works of the Westinghouse Electric and Manufacturing Company is shown in the accompanying illustration. The photograph was taken just as the train was pulling out of the East Pittsburg yards, its destination being the Hauser lake power plant of the Helena Power Transmission Company, at Iron Siding, Mont. The train was composed of nineteen cars, and the shipment consisted, among other apparatus, of the following: four 2,800-kilowatt Westinghouse revolving-field generators, three-phase, 2,400 volts, 7,200 alternations, 227 revolutions per minute, these generators being intended for direct connections to water-wheels. Two 200-kilowatt direct-connected exciters, 125 volts, compound-wound, 475 revolutions per minute, these also being intended for direct connection to water-wheels. Nine 2,000-kilowatt water-cooled transformers, 7,200 alternations, 70,000 volts primary, 2,400 volts secondary.

A large quantity of auxiliary detail apparatus was included in the shipment.

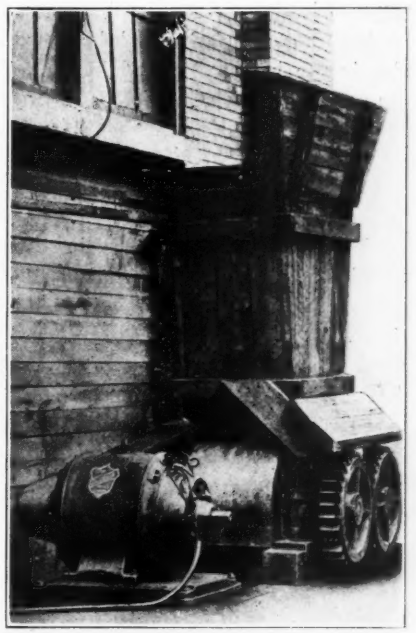
This shipment is an example of the amount of apparatus moving from the Westinghouse works at East Pittsburg daily, where the capacity of the plant, it is said, is being taxed to keep up with the orders.



A Notable Shipment from the East Pittsburg Works of the Westinghouse Electric and Manufacturing Company.

Motor Drive for Coal-Crushing Rolls.

The accompanying illustration shows a set of twenty-four-inch by thirty-inch Allis-Chalmers coal-crushing rolls, belted to an electric motor, such as are now being installed by many users of steam-driven power machinery. In connection with furnaces at which automatic stokers are used, or where for other reasons it is desirable to have the coal crushed to a uniform size, the advantage of such an arrangement will be readily apparent. The coal, as it is unloaded from the car, is passed through these rolls and drops to the hopper which feeds the stokers. Where it is possible to secure coal in hopper cars at all times, a further improvement is made by placing the crushing rolls beneath the track, allowing the coal to drop from the car into the rolls, and falling



Motor-Driven Coal Crusher.

from there to the stoker supply hopper. Motor drive is the most satisfactory for an equipment of this character, as such rolls are in operation for a limited time only each day; there is therefore no waste of power and no idle belts or extra shafting to be cared for while the rolls are not in operation.

The Growth of the Automatic Electric Company.

The growth of the business of the Automatic Electric Company since its incorporation in 1901 has been remarkable. The company has been obliged for the third time since its incorporation to enlarge its plant to enable it to meet the increasing demand for automatic equipment, and is now erecting, on the property adjoining its present plant, southwest corner Van Buren and Morgan streets, Chicago, Ill., a duplicate of the building now in use, to be joined to it by a smaller structure, the administration building, in which will be housed the company's offices.

PLANT OF THE AUTOMATIC ELECTRIC COMPANY, CHICAGO, ILL.

The new buildings, which will be completed and occupied by December of this year, will be of mill construction, brick, with a cream brick facing exactly similar to the present structure.

The factory addition will be eighty-five feet front on Van Buren street and 165 feet deep. It will be six stories high. The administration building will be forty feet front and forty feet deep, the same height as the factory buildings, but the first story will be omitted and the space underneath the second floor used for a driveway to the large court between the two factory buildings. This court will be forty feet wide by 123 feet deep. Fire-walls will separate the administration building from the factory buildings.

The entire frontage of the plant on Van Buren street will be 210 feet. The monotony of such an extensive frontage will be broken by recessing the administration building two feet from the line of the factory structures.

While the actual floor space of the plant will be a little more than doubled, by reason of a most economical arrangement of space, machinery and the routing of the product from start to finish of manufacture, the capacity of the plant will be trebled.

The enlarged plant will be supplied with all that is most modern and most efficient in machinery and appliances for rapidity of manufacture, and the comfort and convenience of operatives.

The various manufacturing departments will be so arranged that the raw material will enter at one part of the plant and will take a direct route through, coming out as finished material at another point.

The completed plant will be one of the finest and best arranged factories in Chicago. The architect is W. Carbys Zimmerman; the contractors are Wells Brothers Company.

The Link-Belt Company.

The two link-belt companies, located respectively at Chicago and Philadelphia, and the Ewart Manufacturing Company, of Indianapolis, will hereafter be known as the Link-Belt Company, and the three plants will be operated at the present locations under one management, of which the following named gentlemen are the official heads: James M. Dodge, Philadelphia, chairman of the board; Charles Piez, Philadelphia, president; Glen G. Howe, Indianapolis, first vice-president; Staunton B. Peck, Chicago, second vice-president; S. Howard-Smith, Philadelphia, treasurer; P. G. Reid, Philadelphia, assistant treasurer; Dyke Williams, Chicago, secretary; Edw. H. Burr, Philadelphia, assistant secretary.

The Chicago house bought both of its associates and under the new name will continue the manufacture of the same type of conveying and power transmission machinery that characterized the previous individual corporations. None of the concerns have been competitors. The Chicago and Philadelphia plants were operated on parallel lines, and the Indianapolis firm, the maker of the original, or as it is known, "Ewart" detachable link-belt, supplied both companies with the conveying and power-transmission chains. The Link-Belt Machinery Company was organized in 1880, establishing a plant at Chicago, and in 1882 opened a branch office in New York city. Six years later saw the Link-Belt Engineering Company succeeding the well-known firm of Burr & Dodge, which was established at Philadelphia and took over the New York office and maintained it in connection with the new works near Philadelphia, as eastern headquarters for the manufacture of the link-belt type of labor-saving machinery. The Philadelphia firm became, too, the manufacturer of all of the apparatus used by the Dodge Coal Storage Company.

The development of the Link-Belt Company has been (in a measure) coincident with the strides made in the electrical field; the modern power-house and appurtenances for handling and distributing fuel being features of the progress that has marked the years since the first labor-saving chain was devised and marketed.

A Tungsten Filament Lamp.

The General Electric Company has for many years been engaged in the development and perfection of a pure tungsten filament for the manufacture of high-candle-power incandescent lamps. Tungsten possesses the property of withstanding very high temperatures, and when used as a filament for an incandescent lamp shows an efficiency of between one and one and one-quarter watts per candle. The life of the tungsten lamp will be at least equal to that of the ordinary incandescent lamp. The recent results attained by the company in the production of tungsten filaments place it in the front rank of those who have been engaged in working upon this difficult problem. Preparations are being made by the General Electric Company for the manufacture of these lamps of high candle power upon an extensive scale.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

NEW CABLE OPEN TO THE ORIENT—The Commercial Cable Company has announced the completion of its new cable to China and Japan. This establishes a system from San Francisco to Honolulu, Midway, Guam and Manilla, and thence to China and Japan. The cable is open for transmission of public business over the lines of the Postal Telegraph-Cable Company.

VIRGINIA WATER-POWER CANAL OPENED—The canal of the Virginia Passenger and Power Company, owned principally by Frank Gould, of New York, is completed. Water was turned in on August 6 for the first time from the Appomattox river. The canal cost $200,000. It will furnish power for the new electric light plant erected near Petersburg at a cost of $300,000 and also for the power plant in Petersburg.

POWER PLANT WORK STOPPED—Work has been stopped on the electric power plant on Cape Fear river, at Buckhorn Shoals. Judge Purnell, of the Federal court, who appointed the receivers, ordered the contractors to continue work, but they will not obey the order. Four hundred thousand dollars has been expended, and a hundred thousand more is needed to finish the work. There are three principal contractors, one local, the others in Richmond and Pittsburg.

TROLLEY FROM PITTSBURG TO CLEVELAND—Pittsburg to Cleveland by traction will be accomplished within a year. Seven contractors employing hundreds of men are at work on the connecting link. Running directly to Harmony the line will open a branch going to New Castle and the other to Butler. The Cleveland line will also connect at Sharon with the Pittsburg road. Engineers have estimated that the line will have a gross earning capacity of $300,000 a year, with net earnings of $150,000. R. H. Boggs, of Pittsburg, is president of the company; M. G. Hibbs, of Pittsburg, secretary and treasurer.

TWIN FALLS LAND AND POWER COMPANY—A scheme for the reclamation of some 400,000 acres of land in Nevada and Idaho, principally on the southern side of the state line, has been formulated by the Twin Falls Land and Power Company, an Idaho corporation—the one which projected the great irrigation scheme, reclaiming hundreds of thousands of acres of land in the southern part of that state. Aside from the irrigation project, it is proposed by the Twin Falls company to furnish electric power for the mines and mills of Contact when the time arrives for the inauguration of the electric system in that promising camp.

CALUMET AND ARIZONA INSTALLS ELECTRIC EQUIPMENT—The Calumet & Arizona Company at Bisbee, Ariz., has completed the installation of an extensive electrical equipment, the power from which is distributed to that company's Oliver and Irish Mag shafts and the Pittsburg & Superior's Junction and Hoatson shafts. Later it will be wired to the latter company's Cole shaft. Pumping by electricity is also planned, and work is now in progress to this end. It is expected that a 600-gallon pump will be in service in the Oliver shaft within the next three months. Electric haulage is also in contemplation, but its details have not yet been worked out.

MARYLAND ELECTRIC MERGER—The Baltimore & Annapolis Short Line and the Maryland Electric Railways Company have been merged by the organization of the Maryland Electric Railways Company, capitalized at $1,200,000. The outstanding $350,000 stock of the Short Line is to be taken over on the basis of three shares of the Electric Railways stock for one of the new. The terms on which the Maryland Electric Railways Company entered have not been made public. The merged properties will authorize an issue of $8,000,000 five per cent bonds, of which one-half will be put out as soon as the consolidation is completed. This issue has already been underwritten by local capital.

MAHONING VALLEY IMPROVEMENTS—The Pennsylvania & Mahoning Valley Railway Company is expending $1,000,000 for improvements to its trolley system which connects Youngstown with Hubbard, Sharon, New Castle, Lowellville, Struthers, Niles, Girard, Warren and nearly every other point in the Mahoning and Shenango valleys. The Sharon-Youngstown branch of the system has been extended to Wheatland, and the work of putting down the track to West Middlesex will be pushed forward rapidly. West Middlesex is six miles from Sharon, and it will be another town connected with Youngstown by the successors of the old Penhale-Devitt syndicate. West Middlesex has a population of 12,000 people, the principal industries are two big blast furnaces, and many of the people when the line is completed will come to Youngstown to do their buying.

BRAZILIAN RUBBER EXPORTS—Consul-General Anderson reports from Rio de Janeiro that Brazilian rubber exports are still on the increase, and quotes some interesting figures. The entries at Manaos and Para from July, 1905, to March, 1906, aggregated 32,840 tons against 31,590 tons in the same period of 1904-1905 and 29,080 tons in the 1903-1904 period. At the two principal rubber-shipping ports of the republic during the month of May there were sixty tons more exports than in the same month last year, and 760 tons more than in the corresponding month of 1904. The entries in January this year, 5,710 tons, broke the record in the history of rubber exports from this or any other country. The United States has been taking considerably more than half of the entire crop, and present indications are that the proportion of the crop going to the United States this year will be larger than usual.

NEW INCORPORATIONS.

EVANSVILLE, ILL.—Evansville Lighting Company. $3,000,000.

ST. LOUIS, MO.—St. Louis Car Lighting Company. $24,000. Incorporators: Edith Foster, Hilda Standinger, John H. Soell and others.

INDIANAPOLIS, IND.—The Chicago & Western Indiana Traction Company. To be known as the "Educational Route." $100,000. Incorporators: Edward H. Bowras, Daniel W. Bolen and John S. McCullough.

ST. LOUIS, MO.—North St. Louis & Suburban Railway Company. $50,000. Incorporators: John Scott, James Scullin, Edward J. Scott, John R. Scott, Thomas W. Murphy, William Scullin and John Scullin.

INDIANAPOLIS, IND.—New York, Boston & Chicago Electric Railway. To touch Hammond, La Porte, South Bend, Mishawaka and Elkhart. Incorporators: W. V. Robinson, E. W. Curtis, J. L. Knox, Charles Schisano and W. M. Watson.

DANVILLE, ILL.—Danville & Eastern Illinois Railway. Principal office at Champaign. To construct from Danville to a point in Vermillion county. $5,000. Incorporators: George M. Mattis, Charles A. Wright, W. H. Burke, Charles Zilly, of Champaign; J. E. Johnson, of Danville.

SPRINGFIELD, ILL.—East St. Louis, Granite & Alton Suburban Railway Company. Principal office, East St. Louis. To operate a line between East St. Louis, Alton and Edwardsville. $2,500. Incorporators: L. C. Haynes, G. Pierce, I. L. Gregory, F. H. Thomas, of East St. Louis, and F. E. Allen, of St. Louis.

SALEM, ILL.—Ohio & Mississippi Electric Railroad Company. To build a line from Centralia north to Sandoval, Patoka, Vernon; west from Sandoval to Odin, Salem and Iuka; north from Salem to Alma and Kennedy, and south from Salem to Cartter and Kell. William Wham, of Cartter, president, and B. Pullen, of Centralia, secretary.

GUTHRIE, OKLA.—Santa Fe, Liberal & Englewood Railroad Company. To build a line from Englewood, Kan., to Des Moines, N. M., passing through Beaver county, Okla. $6,000,000. Incorporators: Frank E. Jennison, New York; Jesse G. Northcutt and A. Watson McHendrie, Trinidad, Col.; John Morrow and Thomas D. Lieb, Raton, with J. H. Albright Hooker as Oklahoma agent.

ELECTRIC LIGHTING.

MALVERN, ARK.—The electric light plant at Malvern, owned by B. W. Turner, has been destroyed by fire.

WILLISTON, N. D.—The city of Williston has opened the bids for the installation of an electric light plant and waterworks.

ORANGE, N. J.—It has been decided to hold a special election for the purpose of deciding whether the people want a municipal lighting plant.

OTTAWA, QUEBEC—The Consolidated Light, Heat and Power Company is the outcome of recent negotiations between the Ottawa electric and Ottawa gas companies.

PIQUA, OHIO—The Piqua city council has appropriated $500 for the securing of an expert electrician to estimate the cost of installing a municipal electric light plant.

LEADVILLE, COL.—An electric light franchise has been granted to Walter W. Davis. It is to run for twenty years, and provides for a substantial reduction from the present rates.

PITTSTON, PA.—The contract to light the city of Pittston has been awarded to the Citizens' Illuminating Company. The price is to be $60 for open arc and $15.50 for incandescent lamps.

GREELEY, COL.—The Greeley Gas and Electric Company has been sold to the Federal Gas Corporation, of Chicago, for $15,000, the purchaser to pay all outstanding debts against the Greeley company.

OGDENSBURG, N. Y.—The Hannawa Falls Power Company is now sending electricity over the new transmission line to Ogdensburg, and it is expected that a number of steam plants will at once be displaced by electric power.

RICHMOND, VA.—An agitation is under way to make use of the old pumping station near Hollywood for conversion into an electric light plant. The property and water power is estimated to be worth from $250,000 to $300,000.

LANCASTER, MASS.—The Clinton Gas and Electric Company has begun the work of placing extra poles in Harvard street for the purpose of extending the lighting system. Twenty-five-candle-power incandescent lamps are used, burning from sunset until midnight.

CAMDEN, N. J.—The city council has decided to submit to the vote of the people at the November election the question of the accepting of the Jones law, passed by the last legislature, permitting cities to construct and maintain electric light plants, for which bonds may be issued.

WORCESTER, MASS.—The Worcester Electric Company has petitioned the board of gas and electric light commissioners for permission to issue 2,000 additional shares of capital stock. It is stated that the growth of business has made necessary improvements to the plant.

PADUCAH, KY.—The contract presented by the General Electric Company, in which it proposed to equip the Paducah city lighting plant for $11,000, has been ratified by both boards of the general council. The mayor was authorized to sign it at once, that the work of equipping the plant might begin without delay.

ELIZABETH, N. J.—A resolution has been introduced into the council and approved, instructing the city attorney to report to the council all proceedings to be taken by the city council to submit to the voters at the next general election the question as to whether or not the people are in favor of a municipal lighting plant.

FRANKLIN, IND.—The Franklin Water, Light and Power Company, which has been controlled by Chicago people for the last five years, has been sold to the Ferris Brothers, owners of lighting and water plants at Yanktown, S. D., and Eldorado and Osage, Iowa. Thomas Ferris, now managing the Osage plant, will assume charge of the local plant.

LYONS, N. Y.—The stockholders of the Wayne County Electric Light Company at their annual meeting elected three directors for the ensuing year. The directors met after the stockholders' meeting and elected the following officers: president, Dwight Chamberlain; vice-president, Charles A. Lux; treasurer, William H. Akenhead; secretary, Attorney Benton S. Rude.

SCHENECTADY, N. Y.—Arrangements have been made by the Schenectady Railway and the Schenectady Illuminating companies for extensive additions to the underground feeder system. On account of the fact that part of the feeders will be used by the railway company and part by the illuminating company, the issues were combined and the work will be done together.

DES MOINES, IOWA—The light committee of the city council has decided to recommend to the city council that each ward of the city be given five additional arc lights or fifteen additional incandescents at the option of the alderman from such ward. The additional lights will entail an added expenditure of $2,000 a year by the city. Fifteen East Des Moines lights have been put on the all-night schedule.

SYRACUSE, N. Y.—The assessment of the plant and franchises of the Syracuse Lighting Company has been materially increased over that of last year. This year's assessment of the company's franchises is $1,660,000, as against $970,000 last year. The total franchise and real estate assessment is about $3,240,000, nearly a million and a half over last year. This will mean an increase in taxes of $25,000.

RUTLAND, VT.—The Rutland Railway, Light and Power Company has taken possession of the electric light plant on Post street recently purchased of the Rutland City Electric Company, and for the present no change in the management or operation of the plant will be made. It is expected, however, that eventually the newly acquired property will be used only as an auxiliary to the company's main plant, and water power will be used instead of steam.

EAU CLAIRE, WIS.—The city council has granted a lighting power franchise for twenty years to the Chippewa Valley Electric Railway Company with only two dissenting votes. The maximum rates for arc lamps are cut to $15 a year less than the old franchise rates, which were $75 per lamp, according to service. The company is to put in a new power plant and also to transmit power from Red Cedar river to Eau Claire for manufacturing purposes.

UTICA, N. Y.—To the Central New York Power Company, of Utica, has been awarded the contract to light the streets of the city of Amsterdam at a cost of $39 a lamp per year, including the building of a conduit system as mentioned in the specifications, the contract to run for a period of five years. The company's authorized capital is $1,000,000. The officers are: president, William E. Lewis; vice-president, H. S. Patten; secretary and treasurer, Byron E. White.

DETROIT, MICH.—Recently the Union Trust Company, receiver of the City Savings Bank, applied to Judge Donovan for an opinion as to whether or not it should expend about $5,000 on the water, sewer and lighting plant on Mackinac Island, one of Frank C. Andrews's ventures held by the company as part of the assets of the defunct City Savings Bank, for the purpose of substantially increasing the revenues of the property and making it more salable. The judge decided that the bonds were a safe investment.

PORTLAND, ME.—The Portland Electric Light Company has bought the Hargreaves Woolen Mill property at West Buxton, and has commenced the construction of a power station for the transmission of electricity for lighting and power purposes in Portland and vicinity. The same company is also to acquire the plants and good will of the Consolidated steam plant and the Portland Lighting and Power Company, operated by water from Great Falls. The purchase of these companies involves the expenditure of $1,000,000.

HYATTSVILLE, VA.—The town council has signed an agreement with the Potomac Electric Power Company, of Washington, to light the streets of Hyattsville for a period of ten years. This will obviate the necessity for the erection of a local electric lighting plant, which has been considered a sure thing. Bids for its construction have already been received and opened. The bid of the Potomac company is a material reduction on its proposition submitted two months ago to agree to furnish thirty-candle-power incandescent lamps for $12 per year and arc lights for $65 per year. The light will be furnished on an actual and not a supposed moon-

light scale, that is the lamps will be dark only on such nights as the moon is not obscured by clouds.

BALDWINSVILLE, MASS.—At a special town meeting the chairman of the electric light board reported that, according to figures submitted by an engineer, the cost of constructing and maintaining within the limits of the town a plant for the distribution of electricity for light for municipal use, and light, heat or power for the use of its inhabitants, would cost about $21,500, or a sum $6,500 in excess of the sum appropriated for the purpose at the special meeting in May. It was voted to appropriate the sum of $6,500 in addition to the sum of $15,000 previously appropriated.

WILMINGTON, DEL.—The street and sewer commissioners of Wilmington have granted a franchise to the Commercial Light, Heat and Power Company, which will secure for the city the company's electric power from the Susquehanna river. The franchise had been pending since 1904. The new concern will give the city three per cent of its gross receipts and will sell electricity to the municipality for two cents a kilowatt-hour. The public rates will be ten cents a kilowatt-hour. These are lower rates than now prevail. The company will expend within one year $100,000 in constructing its plant.

TELEPHONE AND TELEGRAPH.

TOPEKA, KAN.—Construction work on the new building to be occupied by the Independent Telephone Company is to begin at once.

DUNKIRK, N. Y.—The Bell Telephone Company's exchange will be enlarged to provide needed facilities. A new switchboard will be installed.

CINCINNATI, OHIO—Action on the application for a franchise of the Queen City Home Telephone Company has been indefinitely postponed.

LOWELL, MASS.—It is announced that early in the fall a new telephone company will petition for a franchise to construct and operate a telephone system.

DEDHAM, MASS.—The New England Telephone Company will erect a $10,000 exchange on Church street. The building will be of brick with granite trimmings.

BROCKTON, MASS.—The special aldermanic committee has made a request to the Southern Massachusetts Telephone Company to make a reduction of twenty-five per cent in rates.

MANCHESTER, IOWA—At the recent semi-annual meeting of the Delaware County Telephone Company it was decided to lay additional cables in the Manchester residence district.

OSWEGO, N. Y.—The Bell Telephone Company is making plans to remove its poles and wires from the streets and reestablish its entire system in Oswego on the block plan of distribution.

TORRINGTON, CT.—The line of the Southern New England Telephone Company between Torrington and Litchfield has been completed. The rates have been reduced from fifteen to ten cents.

PITTSBURG, PA.—The bid of the Morganstown-Ochiltree Company has been accepted for constructing conduits and laying cables for the police and fire bureaus in Frankstown avenue and Forbes street.

PARIS, ILL.—A serious telephone war is threatened between the Kinloch Telephone Company and the Bell Telephone Company, which, it is said, will build an exchange at Paris in the next sixty days.

BANGOR, ME.—The Aroostook Telephone Company has recently made arrangements for 130 miles of copper wire. When this is installed the company will have a complete copper circuit throughout the county from Danforth to Fort Kent.

MANITOWOC, WIS.—Papers increasing the capital of the Manitowoc & Western Telephone Company to $25,000 have been filed, and the company will start work to extend its lines and improve equipment. The line runs west of the city in the rural districts, and last year declared a dividend of nearly twenty per cent to its stockholders. It is proposed to expend $12,500 at once in improvements, the project contemplating additional lines in Manitowoc and Brown county.

LEAVENWORTH, KAN.—The People's Telephone Company, an independent line, announces that it will put in a new central energy system and will put the wires under ground in the business portion of the city. A building is also to be erected at Sixth and Delaware streets.

LINCOLN, NEB.—The Farmers' Cooperative Telephone Company, of Jefferson county, has filed articles of incorporation with the secretary of state. The officers of the company are: C. W. Robinson, president; J. W. Ulmer, vice-president, and A. R. Sollenberger, secretary. Capital stock is authorized amounting to $15,000.

DANBURY, CT.—The Southern New England Telephone Company is erecting a building to be devoted exclusively to the business of the Danbury exchange on West street, but a short distance off Main street. The building will be two stories high, of brick, with a frontage of thirty feet and depth of fifty feet. The building is to be ready for occupancy before cold weather.

MINNEAPOLIS, MINN.—Because of the increase of its Minneapolis-Chicago business, the North American Telegraph Company is planning extensive improvements between the two cities. A new 300-pound copper line is to be constructed over the line of the Chicago Great Western Railroad. Extensive improvements in some of the old lines are planned also. Work is to be undertaken at once and rushed. Everything in the improvements is to be the newest and best possible.

EASTPORT, ME.—The New Brunswick Telephone Company is planning to extend its service to the neighboring island of Grand Manan, and the work of installing the system will be started at once. Connection with the mainland of New Brunswick, and possibly Maine, will be made by cable, and the advantage of the service to the islanders can not be overestimated. It is expected that fully 200 instruments will be installed as soon as the line is in operation.

PITTSBURG, PA.—Superintendent R. J. Daly, of the bureau of electricity, is busily engaged in the work of placing the public safety utilities under his jurisdiction in such order that there will be no trouble when the telephone and telegraph companies are compelled to remove their poles. Every fire-alarm circuit in the city, the wires of which have been placed in underground cables, is being equipped with the new fire-alarm boxes. Instead of being placed on telegraph poles, as heretofore, the boxes are being mounted on iron pedestals about six feet in height. This work has been completed in the downtown section, and is nearing completion in the Penn avenue district.

NORTHFIELD, VT.—The Northfield Telephone Company has made an advance in its rates. This is found necessary because of the increased expenses due to extension of lines. The new tariff will be $15 yearly for each telephone with no reduction where more than one is used; stockholders will pay this rate the same as other subscribers. A charge of five cents will be made for each outgoing message over other lines the same as has always been charged on incoming messages. The Northfield Telephone Company is a local organization. Some years since it made arrangements with the New England Telephone Company whereby it could connect with its lines.

PORTLAND, ORE.—Contracts are being made between the Home Telephone and Telegraph Company and business men of the central east side district, on the agreement that service will be given probably in forty days, and at least in sixty days. The company has built two exchanges for the east side, and will build three more. The three new exchanges to be started by the company at once are to be located at Sellwood, on Killingsworth avenue, near Michigan, and at Holgate and East Fifteenth streets. Each of the new buildings will cost $15,000 and will be two stories high, with a full basement beneath. Those in charge of the east side work for the company say that the heavy part of the contract has been finished. The setting of miles of pole lines and underground conduits was the chief task, and this is finished.

ELECTRIC RAILWAYS.

ALTOONA, PA.—Altoona capitalists have started a movement for a trolley line between Altoona and Johnstown, a distance of thirty-eight miles. The proposed road is to pass through Patton, Barnesboro and other towns in Cambria county.

HOUSTON, TEX.—The Stone & Webster Company, Boston, Mass., has purchased from the Houston-Galveston Interurban Company all the rights, franchises and privileges of that concern, consisting principally of franchises inside the limits of Houston and Galveston.

PHILADELPHIA, PA.—Between the Philadelphia Rapid Transit Company and the Pennsylvania & New Jersey Traction Company a trackage agreement has been made, which will enable the latter, upon completion of its line, to operate cars into Willow Grove over the Doylestown & Willow Grove line.

GALVA, ILL.—At a special meeting of the Galva city council, a franchise was granted to the Galesburg & Kewanee Electric Railway Company to construct, maintain and operate a system of electric railways on certain streets in the city of Galva for a period of twenty years. Previous to this a motion that the term of the franchise be fifty years was voted down.

WELLSVILLE, OHIO—The East Liverpool Traction and Light Company has closed deals for a complete right of way between Wellsville and Empire, Ohio, and will begin immediately the construction of an extension westward. This will give the company a through line from Smith's Ferry, Pa., to Brilliant, Ohio, passing through East Liverpool, Wellsville, Empire and Toronto, Ohio.

NEW YORK, N. Y.—At a meeting of the directors of the Philippine Railway Company the following officers and directors were elected: William Salomón, chairman; Charles M. Swift, president; H. M. Steele, first vice-president; C. Lewis, treasurer; P. H. Ashmead, secretary. Directors: William Salomon, Charles M. Swift, Cornelius Vanderbilt, Alonzo Potter, C. Lewis, Thomas H. Hubbard, J. G. White, Frederick H. Reed, Henry R. Wilson.

INDIANAPOLIS, IND.—The Indianapolis & Western Traction Company has let the contract for building its line between Greencastle and Brazil. McArthur Brothers, of Chicago, will do the grading, and the National Concrete Company, of Indianapolis, the concrete work. The materials for the tracks are now being delivered. The company is about to complete its line as far as Danville and will probably finish the Greencastle extension by the first of the year.

SEATTLE, WASH.—The West Seattle city council has set a price of $30,000 on its street railway and light plant—the only municipally owned street railway in the country—and the Seattle Electric Company has signified its acceptance of the terms, the sale being provisional with the approval of the taxpayers of that city, who will be given an opportunity to vote on the issue. The fund realized would be devoted to the establishment of municipal water, lighting and sewer systems.

LYNCHBURG, VA.—The Lynchburg Traction and Light Company has purchased more than a half a square of property fronting on Main street, between Fifth and Sixth streets, on which it purposes to erect a building for its general offices and car sheds. This will do away with two division sheds, concentrating all of the operation of the entire system of the city at this one point. The new car barns are to be equipped in the most modern manner, the plans already having been drawn for the buildings.

FORT SMITH, ARK.—At a meeting of the Commercial Club and representatives of the railroad projected from Fort Smith to Prairie View, Logan county, the club agreed to donate the right of way and terminal facilities for the road at Fort Smith. It was stated by the representatives that the road will spend $2,500,000 in the building of the line and that its headquarters would be established at Fort Smith. The road, it is said, will in the course of time be extended to Memphis in a direct air line. The road is primarily for the purpose of opening some large coal land holdings which the backers of the road own and which they propose to develop on a large scale.

WALLS, PA.—Residents of Walls expect in the near future to have communication with the outside world by means of a trolley car line. A new project assures a line that will be of more advantage than an original proposition which, it is said, has fallen through. During the past two or three weeks engineers have been running a line for a private right of way for the road, and many options on valuable property between Walls, Wilmerding, Turtle Creek and East Pittsburg have been secured. Plans of the promoters include connection with the lines of the Highland Grove Electric Company. Bowman Brothers, of Wilmerding, Pa., are said to be leading spirits in the enterprise.

MODESTO, CAL.—The statement that Modesto and Stockton will soon be joined by an electric line has been made by a director of the Western Pacific Railroad, although he will not admit that his company is behind the project. The road will enter Modesto on the north, following the McHenry road or a right of way adjacent. The new road has nothing to do with the county franchise now lapsed under which H. B. Kinney, a year ago, sought to win support to his proposed Riverbank-Modesto line. Applications will be made to the county supervisors for other franchises traversing new lines of travel and reaching the city through the tracts now developing for home sites north of town.

CLEVELAND, OHIO—The Cleveland, Ashland & Mansfield, upon which construction has just been started, has been granted franchises in Richland, Ashland and Wayne counties. It has yet to obtain a franchise in Medina county. The road is to be built the entire distance between Seville and Mansfield over a private right of way, and in consequence the franchises in question carry only privilege to cross cross-roads where that becomes necessary. The intention of the management is to build a line from Ashland to Mansfield first, and the indications are that this will be completed late this fall or by the first of January. The line from Ashland through to Seville will take a longer time, and will not be finished until the latter part of next year.

EAST LIVERPOOL, OHIO—Officials of the Youngstown & Ohio River Railroad have been approached by officials of the Ohio River & Northern Railroad seeking a consolidation of the two companies for at least a connection to be made at West Point. The Youngstown & Ohio River has started an electric line from Youngstown to West Point, and the Ohio River & Northern has secured the right of way from West Point to Wellsville and is now trying to get a franchise in East Liverpool. If the connection is made at West Point there will be a through line from East Liverpool to Youngstown, and the terminal and intermediate points will be supplied with coal from West Point fields. Persifor F. Smith, of Pittsburg, is the principal stockholder behind the Ohio River & Northern Railroad.

POTTSTOWN, PA.—Work will be begun in thirty days on the construction of an electric railroad from Pottstown to Paoli by the Philadelphia Interurban Railway Company, an organization chartered under the laws of Pennsylvania some time ago. Right of way between the two points has been secured and it is understood that the new line will reach Sixty-third and Market streets, Philadelphia, over the tracks of the Philadelphia & Western Railroad. The line will run through Phoenixville, Linfield, Royersford, Valley Forge and a number of small intermediate towns and boroughs, serving a population of about 2,500 a mile. The new company is capitalized at $3,000,000 common stock at $50 par, and $3,000,000 five per cent bonds. The stock is full paid and sufficient bonds, it is understood, have been placed to finance the present needs and warrant beginning the construction of the road.

SYRACUSE, N. Y.—At the annual meeting of the Syracuse & Suburban Railroad Company at Suburban park, the matter of extending the road was left to the executive committee, it being practically decided to build from Manlius through Cazenovia and Delphi to Deruyter. The proposed extension will add eighteen miles to a road now twelve miles long. The line will be double-tracked, according to present plans, making thirty-six miles of new track. In round numbers the track, power and equipment will cost $1,000,000. It has not been decided how the project will be financed. The capital stock of the Syracuse & Suburban company may be increased, a new company may be incorporated to take over the Suburban or a new company may be organized to build the extension and the two companies merged later. The capital for the undertaking will be furnished by New York and Philadelphia men, principally by the former, it is understood.

PERSONAL MENTION.

MR. R. B. WISEMAN has been appointed manager of the Missoula (Mont.) exchange of the Rocky Mountain Bell Telephone Company.

MR. FREDERICK L. MARSHALL, of Centralia, Ill., has been appointed superintendent of the gas and electric company at Hopkinsville, Ky.

MR. E. I. EMERSON has been made manager of the Portland (Me.) exchange of the New England Telephone and Telegraph Company. Mr. Emerson entered the employ of the telephone company in 1901, and was manager of the company's Burlington (Vt.) exchange since February 1, 1905.

MR. R. M. SEARLE has assumed the duties of the general manager of the Rochester (N. Y.) Railway and Light Company. Mr. Searle was connected with the Westchester Lighting Company, Mount Vernon, N. Y. Previous to that he was general manager of the Atlanta (Ga.) Gas Light Company.

MR. WINTHROP G. BUSHNELL, the well-known electrical magnate, has a summer home at the beautiful Sound shore resort of Pine Orchard, Ct. At a recent meeting of the leading residents Mr. Bushnell was honored by the appointment to the position of police commissioner of Pine Orchard, and a handsome diamond-studded badge of office was given him with eloquent words of appreciation. The recipient responded with much emotion, and declared his intention to do his duty conscientiously and fearlessly. The New Haven *Register* said: "The people of Pine Orchard will feel perfectly safe from every annoyance with Mr. Bushnell at the head of their police force. Mr. Bushnell wears his badge of office with great pride. A dinner followed the surprise."

MR. JOHN C. KILDAY has been appointed superintendent of the new Portland district of the New England Telephone and Telegraph Company. Mr. Kilday worked for the Western Union Telegraph Company as a messenger boy, soon securing a position of trust in the cashier's office at Portland. He later went to the Boston office of the Western Union as right-hand man to Mr. J. H. Wentworth. In 1894 he entered the office of Superintendent George S. Dresser, then in charge of the underground construction and maintenance work of the Boston division of the New England Telephone and Telegraph Company. He was made chief clerk, remaining with Mr. Dresser after the latter became general superintendent of construction. Three years ago Mr. Kilday became assistant superintendent of the eastern division.

OBITUARY NOTICE.

MR. CARLTON KING, of New York, died at Fort Collins, Col., August 5, at the age of thirty-five years. He attended the Elk's convention in Denver and contracted a cold which resulted in pneumonia. He was sick two weeks. He went to Colorado from New York four months ago and was made president and manager of the Northern Electric Company, the largest power and light company in the state.

ELECTRICAL SECURITIES.

In the earlier stages the market was more or less buoyant, but toward the close of the week a sagging tendency developed and speculation ranged within very narrow limits. At present, as far as internal affairs are concerned, the harvest holds the attention of all. The yield predicted is of a bounteous order with the inference that the demand and quality are so good that a new peak in the wave of prosperity will be developed. General business conditions, according to all reports, continued highly favorable during the week, and statements of railroad earnings showed gratifying increases. The figures of New York Central and its allied lines for the month of July were highly satisfactory, and would probably have offset the effect of the selling of the 3½ per cent bonds had it not been that the market had become entirely professional, and that for the time being no influential efforts were made to sustain it. A good deal of disappointment has been expressed in various quarters that the public had not responded to the recent advances in the market, but there was a strong feeling in many quarters that should the anticipated stringency in money fail to materialize, the coming fall would be marked by a broader and more wholesome speculation than has been seen in Wall street at any time in the present year.

ELECTRICAL SECURITIES FOR THE WEEK ENDING AUGUST 11.

New York:	*Closing.*
Allis-Chalmers common	17⅝
Allis-Chalmers preferred	46½
Brooklyn Rapid Transit	78
Consolidated Gas	140
General Electric	167
Interborough-Metropolitan common	35½
Interborough-Metropolitan preferred	75½
Kings County Electric	160
Mackay Companies (Postal Telegraph and Cables) common	74
Mackay Companies (Postal Telegraph and Cables) preferred	73
Manhattan Elevated	140
Metropolitan Street Railway	108
New York & New Jersey Telephone	127½
Western Union Telegraph	91¼
Westinghouse Manufacturing Company	152

There was considerable interest in the quarterly statement of the local traction lines. Traffic in the subway is showing increases of 10 to 20 per cent a day over the corresponding days last year; the elevated lines show gains, although at a much smaller rate, and the surface roads are gaining also. Up to the end of May, Metropolitan was $500,000 ahead as compared with the corresponding period a year ago, and in the four months ended June 30 the three systems earned enough to show almost the full proportion of the dividend for Interborough preferred stock.

Earnings of the Brooklyn Rapid Transit system continue to show exceedingly satisfactory gains over a year ago. The average gain for July was $2,000 a day. Earnings on Sunday, July 22, were $76,000, an increase of $20,000 and on July 1, were between $75,000 and $80,000. The company's record day showed earnings of $81,000.

The directors of the Kings County Electric Light and Power Company have declared the regular quarterly dividend of 2 per cent, payable September 1. Books close August 18 and reopen September 1.

Boston:	*Closing.*
American Telephone and Telegraph	131½
Edison Electric Illuminating	240
Massachusetts Electric	68½
New England Telephone	130
Western Telephone and Telegraph preferred	85

The telephone stocks suffered a slight decline at closing. Local business was very dull, the intensely hot weather apparently driving away all traders.

Philadelphia:	*Closing.*
Electric Company of America	11
Electric Storage Battery common	70
Electric Storage Battery preferred	70
Philadelphia Electric	8½
Philadelphia Rapid Transit	30
United Gas Improvement	86½

Philadelphia market was dull and heavy, although local electrical issues made gains over the figures of a week ago.

Chicago:	*Closing.*
Chicago Telephone	118
Chicago Edison Light	135
Metropolitan Elevated preferred	67¼
National Carbon common	81¾
National Carbon preferred	118
Union Traction common	4
Union Traction preferred	14

The new protective committee of stockholders of the Chicago West Division Railway Company, consisting of Byron L. Smith, Cyrus H. McCormick, Chauncey Keep and John F. Bass, intend, it is said, to block the present plans for financial reorganization of Union Traction. In a circular to the stockholders they call attention to the supplemental bill filed by the Guarantee Trust Company, of New York, asking for a new set of receivers for all the companies to facilitate a sale of the properties. The communication is addressed also to the stockholders of the North Chicago. The committee warns the stockholders that if a sale were accomplished, as proposed, they would get nothing, or very little. It objects to the proposed issuance of receivers' certificates to pay for the removal of the tunnels. Objecting stockholders are depositing their stock with the Merchants' Loan and Trust Company, and contributing $1 per share toward a fund for legal service.

The Chicago Telephone Company during July gained 1,552 telephones. The total number now in use is 158,874.

INDUSTRIAL ITEMS.

THE C. O. SCHNEIDER COMPANY, Chicago, Ill., is the manufacturer of the thermostatic flasher used with the flashing sign described in the issue of the ELECTRICAL REVIEW for July 28.

LINDSTROM, SMITH COMPANY, 59 Dearborn street, Chicago, Ill., has placed on the market a vibro-massage machine, descriptive matter concerning which they will be pleased to send upon request.

THE MOORE ELECTRICAL COMPANY, 52 William street, Newark, N. J., has ready for distribution a new booklet describing the Moore tube light. In addition to the text the booklet shows illustrations of various installations of this system of lighting.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., will be pleased to send the Emerson monthly to parties interested in all kinds of electrical machinery. This periodical contains a bargain list of second-hand apparatus and numerous sketches calling attention to adaptations of Emerson apparatus.

THE WESTERN ELECTRIC COMPANY, Chicago, Ill., is furnishing the entire switchboard equipment for the Winona Lake Interurban Railway Company, which is building a new line at Winona Lake, Ind. There will be a main station board and three smaller boards for substations. The transmission voltage will be 35,000.

THE O. C. WHITE COMPANY, Worcester, Mass., has published a very handsome catalogue describing its standard adjustable fixtures for incandescent lamps in plain forms and in combination with gas fixtures. These fixtures are adaptable for shop, mill and factory; drawing room, office and bank; house, library and dressing room.

THE POWER AND MINING MACHINERY COMPANY, Cudahy, Wis., has published an attractive bulletin describing the Loomis-Pettibone gas-generating system operating gas engines for power. This is designated as publication No. 102. In addition to the descriptive text, there is a large engraving in colors showing the complete cycle of operations in the gas-generating system.

THE ATLAS ENGINE WORKS, Indianapolis, Ind., would be pleased to send to any one interested bulletin No. 131 describing throttling and automatic single-valve engines. This bulletin contains a carefully arranged treatise on the subject of Atlas single-valve engines, and, in addition to the text, shows numerous views of the assembly and several reproductions of indicator diagrams. There are also several tables giving complete specifications on five different classes of Atlas engines.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., has issued the sixth edition of price list "A," which includes a description of all types of the "Chloride Accumulator" applicable to central station lighting and power, electric railway power, isolated lighting and power stations, railway car lighting, etc. In this addition is also catalogued auxiliary apparatus used in connection with "Chloride Accumulator" installations. This price list will be forwarded, upon application, to the general offices at Philadelphia or to the sales offices throughout the United States.

THE BRISTOL COMPANY, Waterbury, Ct., will be pleased to send to any one interested its descriptive bulletin No. 41, which simply touches upon the many different types and ranges of the recording instruments made by this company. Owing to the convenient size of this bulletin and the brevity of the descriptive matter, it is believed that it will be used as a file for easy reference when in need of information concerning recording instruments. These bulletins are not intended to take the place of the large illustrated catalogues and price lists, any of which will be sent upon application.

THE GOULD STORAGE BATTERY COMPANY, New York, N. Y., has secured a permanent office in the Monadnock Building, San Francisco, Cal., from which point all Pacific coast business will be handled. Owing to the growth of business with consequent demands for a closer base of operations, the company has found it necessary to establish a Canadian branch with offices at 62-64 Wellington street West, Toronto, Ontario, with P. B. Yates in charge. Besides the regular line of storage batteries for load regulation in connection with the Gould counter-electromotive-force booster for street-railway lighting and power-plant systems, the Gould Storage batteries are being manufactured for use in train lighting and also for telephone and telegraph work. The company has now in press a booklet on telephone batteries, which it will be pleased to send, without charge, to those interested.

THE AQUALITE FIRE-PROOFING PAINT COMPANY, 141 Broadway, New York city, has ready for distribution a circular setting forth the principal points regarding "Aqualite" hot-water paint for weatherproofing and fire-retarding. This is a hot-water paint put up in a powder form for either outside or inside use. It presents a hard surface, and the manufacturer claims it will not rub off, flake or peel, and is not affected by dampness in any manner. It can be applied with either a brush or spraying machine, and one barrel of dry paint mixed with boiling water will cover from 8,000 to 12,000 square feet of surface.

THE AMERICAN INSTRUMENT COMPANY, Philadelphia, Pa., has issued a comprehensive catalogue of direct-current switchboard and portable voltmeters and ammeters. In addition to general descriptive matter with illustrations the catalogue contains data as to dimensions of switchboard instruments and shunts, together with necessary particulars for drilling switchboards. The catalogue is decidedly attractive in appearance, and should be obtained by all who have occasion to buy or use electrical instruments. Enquiries for it should be addressed to James G. Biddle, general sales agent, 1114 Chestnut street, Philadelphia. The company's factory is at Newark, N. J.

THE AUTOMATIC ELECTRIC COMPANY, Chicago, Ill., announces that every large city on the Pacific coast from San Diego, Cal., to the northern border of the United States has now adopted its automatic telephone system. The contract for the last large city, Spokane, Wash., was signed recently between the Home Telephone Company, of Spokane, Wash., and the Automatic Electric Company. It calls for the building and installation of a 3,500-line automatic exchange of the most modern type, together with power appliances, telephones, etc. San Diego, Los Angeles, San Francisco and Oakland, Cal.; Portland, Ore., and Walla Walla, Tacoma, Bellingham and Spokane, Wash., all having automatic installations, will be important factors in an extensive long-distance system being worked out on the coast by local capital.

THE HOLOPHANE GLASS COMPANY, New York city, announces that the central stations of the country are rapidly awakening to the necessity of giving their customers not only the maximum amount of light, but also the best illumination possible. An example of this awakening to the need of better illumination is that of the Portland General Electric Company, Portland, Ore., which has secured the services of H. N. Lauritzen of the engineering department of the Holophane Glass Company for a period of two months to assist them in the designing of lighting of numerous installations which are now under way, to assist the architect in the correct laying out of the lighting scheme before the buildings are wired, and also to instruct their salesmen to lay out the lighting in order to get the best illumination possible. So great has been the demand for this class of work that the Holophane Glass Company announces that for the present no more engagements can be made for members of its engineering staff for work of this kind.

NEW MANUFACTURING COMPANIES.

ALBANY, N. Y.—The Simplex Telephone Equipment Company has been incorporated with a capital of $100,000. The headquarters of the company will be at Rochester.

AUGUSTA, ME.—The American Telemestic Company has been organized for the purpose of dealing in electrical instruments, with a capital of $1,500,000. The officers are: president, A. M. Macomber, Augusta; treasurer, E. J. Pike, Augusta.

BALTIMORE, MD.—The Electrical Construction Company has been incorporated to manufacture and install electrical wires and apparatus by Ambrose Fleming, Kenneth Fraser, B. Carroll Shipman, Harry K. Brooks and Elmer J. Jones. The authorized capital stock is $5,000, divided into 500 shares of $10 each.